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CONTENTS

	Page
Automatic dust-sampling and analyzing instrument for atmospheric pollution surveys. (7 figs.) W. F. Davidson and Warren Master	257
The geometrical theory of halos—VI. (2 figs.) Edgar W. Woolard	260
Recalibration of instrumental equipment at solar radiation stations. Irving F. Hand and Helen F. Cullinane	262
Tropical disturbances of September 1941. (1 lithograph.) Howard C. Sumner	264
NOTES AND REVIEWS:	
W. E. Knowles Middleton. Visibility in Meteorology. *Review*	266
Sverre Petterssen. Introduction to Meteorology. *Review*	266
METEOROLOGICAL AND CLIMATOLOGICAL DATA:	
Aerological Observations	266
Weather on the North Atlantic Ocean	273
Weather on the North Pacific Ocean	274
Typhoons and depressions over the Far East. Bernard F. Doucette, S. J.	275
River Stages and Floods	277
Climatological Data	281
SOLAR RADIATION AND SUNSPOT DATA:	
Solar Radiation Observations	289
Positions, Areas, and Counts of Sunspots	290
Provisional Relative Sunspot Numbers	291
CHARTS I–XI. (Chart VII—snowfall—discontinued until November.)	

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MONTHLY WEATHER REVIEW

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AUTOMATIC DUST SAMPLING AND ANALYZING INSTRUMENTS FOR ATMOSPHERIC POLLUTION SURVEYS

By W. F. DAVIDSON and WARREN MASTER

[Consolidated Edison Co. of New York, Inc., October 1941]

INTRODUCTION

A few years ago, Consolidated Edison Co. of New York began a survey of atmospheric pollution. The Weather Bureau is now cooperating in this survey; and it is considered that a description of the instruments used in this research will be helpful to everyone interested in the program. These instruments have been developed during the course of the survey and they have been found entirely satisfactory.

None of the available recording instruments used in previous surveys of this nature was entirely satisfactory. It was deemed desirable, however, to retain the advantage of a basis of comparison with earlier studies. This was done by improving the Owens automatic air filter; during the development, the serious defects of this instrument were eliminated, but its essential features were retained so that present records are comparable with previous records.

The automatic air filter, developed by J. S. Owens for the British atmospheric pollution survey, consists of a time-controlled water syphon which periodically draws 2,000 cubic centimeters of air through an orifice pressing on the periphery of a filter paper disk. The diameter of the orifice is one-eighth of an inch. The dust concentration is determined by measuring the degree of the darkening on the filter papers, and applying a conversion factor to express the results in "tons per cubic mile" or corresponding other units.

The most serious objection to the Owens recorder was the use of water. In winter it was necessary to operate this instrument inside where water supply was available. Inside operation required an objectionably long sampling tube. A less serious difficulty in the Owens recorder was the use of a circular chart requiring daily change. Records of these earlier surveys were subject to inaccurate evaluation because of the lack of a device for measuring the degree of darkening, or shade number, on the filter paper.

IMPROVED AUTOMATIC SAMPLER

Since 60-cycle alternating current services with regulated frequency are generally available at all locations where the samplers may be installed, it was decided to make the new instrument electrically operated. A motor-driven exhaust pump and a diaphragm gas meter for measuring the air volume were substituted for the water syphon of the Owens recorder. A small synchronous motor of the telechron type was used for time control and the disk record of the older instruments was replaced by a strip chart. A minor change, made in the interests of facilitating the measurement of the degree of darkening, consisted in enlargement of the dust-spot area from ⅛-inch diameter to 5/16-inch diameter. The instrument, as finally developed, is shown photographically in figure 1 and schematically in figure 2.

The arrangement and method of operation of the instrument is readily apparent from figure 2. Timing and the movement of the record tape are controlled by the small synchronous motor (1) operating through reduction gearing to drive a shaft at 1 revolution per hour. Mounted on this shaft is a cam (2) which moves switch (17) alternately from one position to the other each half hour, thus completing the circuits necessary to start the train of sampling operations. A Geneva gear intermittent motion (3) operates the feed drum (5) and the take-up reel (7) in such way as to advance the record tape three-fourths of an inch between sampling periods. When switch (17) moves

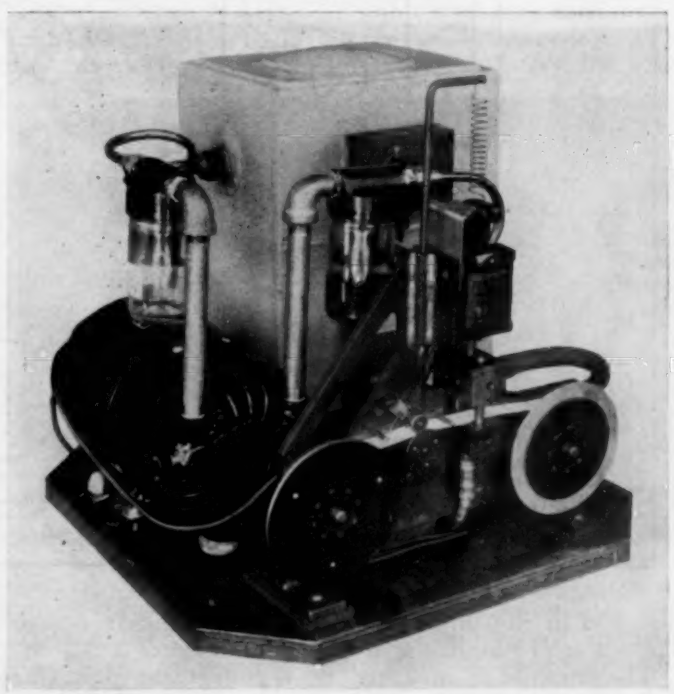


FIGURE 1.—Automatic strip-chart dust sampling machine with cover removed.

to "start" position (as indicated) circuits will close, energizing the solenoid magnet (10) which forces the clamping blocks (9) on to the record tape. At the same time, the motor (12) driving the exhaust blower will start. This will draw a sample of air from intake (8), through the filter paper record tape and will discharge it to atmosphere through the meter (14) where the quantity is measured. When 1 cubic foot of air has passed through the meter, the cam (15) will move switch (16) to the opposite position, opening the circuits, thus stopping the exhauster and allowing the clamping blocks to separate, freeing the record tape. The size of the exhauster is such that the sampling operation requires about 6 minutes.

The decision to use strip record tapes instead of disks made it necessary to solve several problems. The tapes were to be 16 mm. wide and about 60 feet long, enough for 20 days' operation. The filter paper selected is similar to that used by Owens. It is of superior grade white stock with a porosity of 12 to 15 seconds per 100 cc. of air as measured by the Gurley densometer. The reflection coefficient (white light) is 0.84 as determined by Hardy recording spectrophotometers. It was necessary to develop an accurate indexing of the dust spot for the photometer which was to be used for determining the degree of darkening. The use of a perforated tape for indexing purposes was impractical because of shrinkage and expansion with changes in moisture content. The problem was solved by incorporating a punch in the clamping blocks (9). Two punch pins were mounted in the upper block on opposite sides of the 5/16-inch (7.94 mm.) diameter orifice, and corresponding holes were drilled in the lower block. These punches thus index an unperforated tape. The indexing holes are accurately punched in the tape on each side and directly opposite the center of the dust spot as shown in figure 3.

The sampler is mounted on a convenient pipe frame stand as shown in figure 4. It is protected by a metal cover which also serves to hold a deposit gage. The inlet tube extends a few inches below the instrument base.

The principal component parts were purchased from regular commercial sources.

CHART-EDITING MACHINE

The use of plain strip material for charts made it necessary to edit the individual records after they were removed from the sampler in order to determine the time of the records. The only previous notations on the record were the time of the first and the last dust spots. To facilitate the time determination, the chart editing machine, shown in figure 5 was constructed. This machine was constructed so that a small pin can move into the perforations on the side of the tape made by the punch. The movement of the pin operates an electrical counter circuit or gives an audible indication of the time.

PHOTOELECTRIC SCANNING MACHINE

The use of a semiautomatic photoelectric scanner for determining the "shade number," or degree of darkness of the dust spots on the record tape, was considered essential for the investigation. The method of making a visual match with a standard scale of grays, as used by Owens, was not only slow and laborious but open to serious error unless trained observers were used. Even with trained observers the statistical sampling variance would, *a priori*, be quite large as compared with a more rigorous and specific scientific technique. The ratio of the pollution of an actual sample to the pollution of the fixed sample will not exceed 2 to 1; therefore the range in brightness of the spots is not great. Such small range would require the matching of brightness to 5 percent in order to read 1 unit on a scale of 10. Such accurate matching is beyond the ability of random observers unless the lighting and other conditions of observation are carefully controlled.

The photoelectric scanning machine is shown photographically in figure 6 and schematically in figure 7. The photometric system consists of a tungsten filament lamp (20) operated at fixed voltage from a constant voltage transformer (19) with the filament focussed, by a single lens (21), to a spot about 7 mm. diameter on the record tape. Reflected light from the spot is picked up by a barrier-type self-generating cell (22). Since it was desirable to have a pointer-type indicating instrument (23) connected so that it would read zero for the unsoiled tape and show increased deflections as the spots became darker, a compensating circuit was provided to neutralize the voltage from the cell when the unsoiled tape was in position. In operation, a section of unsoiled tape is

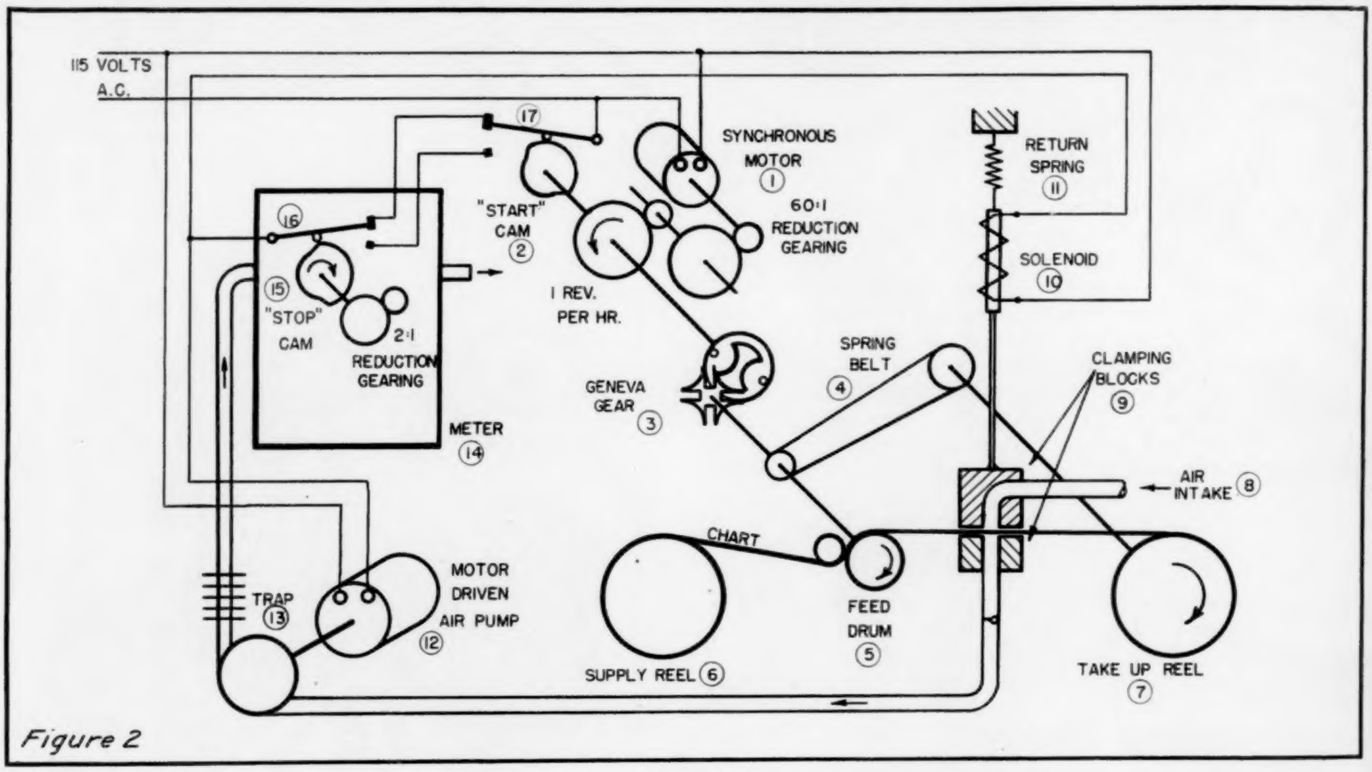


FIGURE 2.

placed in the measuring position and adjustment (24) is used to bring the meter to zero reading. A standard gray chart of known shade number is then introduced and the sensitivity adjustment (25) is used to bring the pointer

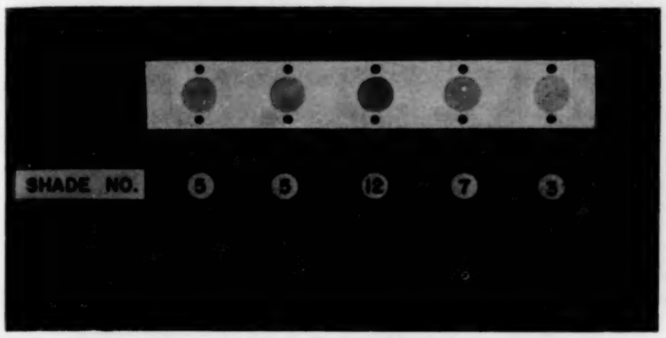


Figure 3.—Section of typical dust chart showing punched holes and shades of gray obtained with partial range of dust concentrations encountered.

to the proper deflection. If necessary, the adjustments are repeated for more certain check.

The chart is moved forward from position to position by an automatic mechanism under the control of the

Figure 4.—Dust sampling station on roof of a 20-story New York building. Funnel-shaped device on cover measures fall of large-size dust particles.

operator. To move the chart the operator presses "start" button (32), thus energizing solenoid (34) and causing it to withdraw the pin (31) from the indexing hole in the tape. At the same time, contacts (35) are closed (the switch (37) having been closed to make the machine operative) and this starts motor (33) which advances the tape. In the meantime the operator has released push button (32) deenergizing the solenoid, but the switch (35) is kept closed by the pressure of the tape on the pin. When an indexing hole comes into position, pin (31) rises, opening contacts (35) and stopping the feed motor. The presence of the pin in the tape holes and elasticity of the tape between that point and the feed drum insure the accurate position of the dust spot under the focussed light spot. The small contactor (38) is provided merely to give added damping to the meter and prevent violent needle swings between spots.

In determining the scale of shade numbers, black was arbitrarily assigned a value of 50; but as a matter of con-

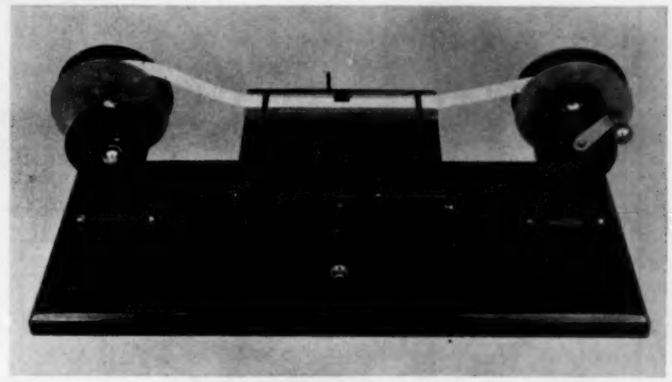


Figure 5.—Chart-editing machine for inspecting, marking, and splicing charts for scanning machine.

venience and to get a better instrument scale, the scale was divided into 20 units. A calibrated gray card is used for making adjustments as previously described. The gray for shade No. 20 has a reflection factor for white

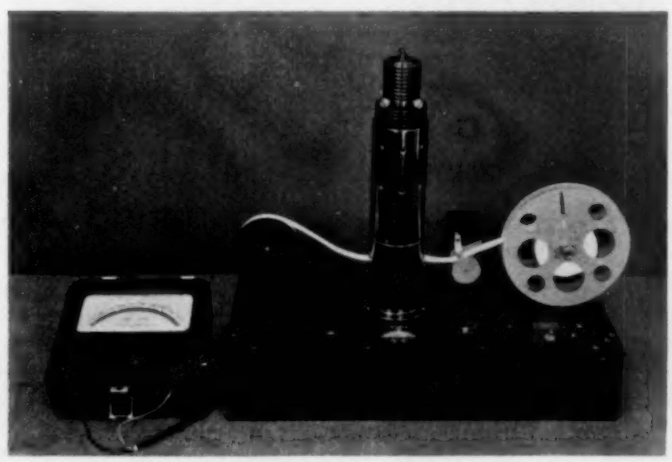


Figure 6.—Photoelectric scanning machine. Note special shade number scale on microammeter.

light of 0.48, as measured by the Hardy photometer, with nearly uniform values throughout the visible spectrum (i. e., it is a true gray). This method of shade determination has a distinct advantage over visual matching with a standard chart. Since the instrument is adjusted to read zero on the unsoiled chart, no discoloration of the tape due to age will affect the shade-number readings. This important advantage is apparent. On some unused Owens charts, after several years of storage, background readings corresponding to shade 2 were obtained when no initial correction was applied.

Readings to better than one-half shade number on the scale of twenty are obtained; but for survey purposes, readings are reported to the nearest whole number.

The principal component parts of this instrument also were purchased from regular commercial sources.

It is planned to present in another paper the results obtained with this instrument in an atmospheric-pollution survey of the New York City metropolitan area.

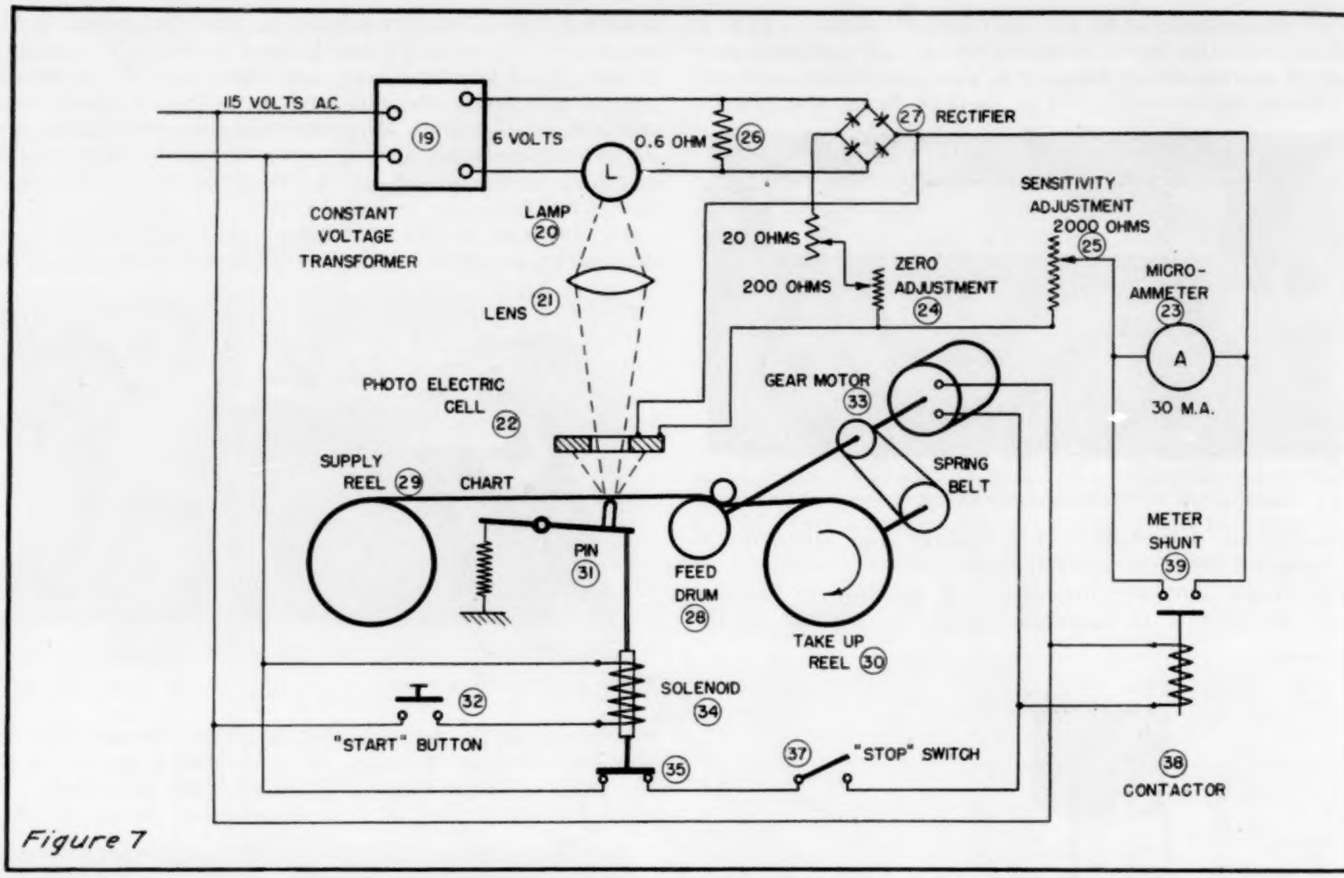


FIGURE 7.

THE GEOMETRICAL THEORY OF HALOS—VI [1]

By EDGAR W. WOOLARD

[Weather Bureau, Washington, D. C., September 1941]

PART 3. THE OPTICAL METEORS PRODUCED BY ICE CRYSTALS IN THE ATMOSPHERE

Among the innumerable crystalline forms produced by the condensation of water vapor in the atmosphere at temperatures below freezing, as illustrated, e. g., in frost-work and by snowflakes, there are two or three quite simple ones from which all the others may be built up, viz, hexagonal columns with or without pyramidal caps (complete or truncated) and hexagonal plates; the columns are sometimes capped with plates, and the pyramids may occur unattached to columns.

These elementary forms (figure 19) are frequently observed in snow and frost at low temperatures, especially in polar regions; they often are present in the atmosphere at the surface of the earth when a halo display is witnessed, and there is every reason to believe that it is some one or more of them, or simple combinations thereof, which ordinarily produce halos, and not the complicated crystal groups and patterns shown in general by snowflakes—in fact, the majority of authenticated halos do not require anything more complicated than a simple hexagonal right prism (column or plate).

The present investigation will therefore be restricted to hexagonal right prisms (in the form of either columns or disks), hexagonal right pyramids (complete or truncated), and simple combinations of these two forms.

[1] The previous papers have appeared in the MONTHLY WEATHER REVIEW as follows: I, 64:321-325, 1936; II, 65:4-8; III, 65:55-57; IV, 65:190-192; V, 65:301-302, 1937. The figures in the present paper are numbered consecutively with those in the earlier papers.

From the six lateral faces and two bases of a hexagonal right prism, taken two at a time, may be formed 28 possible combinations. Of these combinations, one consists merely of the two bases, which form a refracting angle of 0° and do not produce any resultant deviation; 15 are combinations between lateral faces, of which 3 are between opposite faces and again form 0° angles, and 6 are between adjacent faces and form angles of 120° through which no transmission is possible; 6 are between alternate faces, and all form truncated 60° refracting angles; 12 are combinations of a lateral face with a base, forming in all cases a refracting angle of 90°.

To determine all the halos which a hexagonal right prism with plane bases is capable of producing, it is necessary to calculate, for each of all orientations of the prism in space, the images obtained by refraction through the six 60° angles between alternate lateral faces and through the twelve 90° angles between lateral faces and bases, together with the images formed by reflection (external, and internal with or without accompanying refraction) from the six lateral faces and two bases. The refracting edges of the 60° angles are parallel to the principal axis of the crystal, and those of the 90° angles are perpendicular to the principal crystal axis.

In pyramidal crystals, the triangular faces may, according to the laws of crystallography, have any one of several different inclinations to the principal axis of the crystal, these different values being connected by simple numerical relations. Unfortunately, the possible inclinations can be

determined only by actual measurement of the particular one of them that some actual crystal happens to have; an ice crystal is a difficult thing to measure—few such measurements have been made, and they necessarily are more or less inexact. Hence the values of the possible, and of the actually occurring, inclinations are somewhat uncertain. The most probable value—one determined in part from the evidence of the halos themselves—seems to be the one deduced by Humphreys,[2] viz, 24°51′, and it

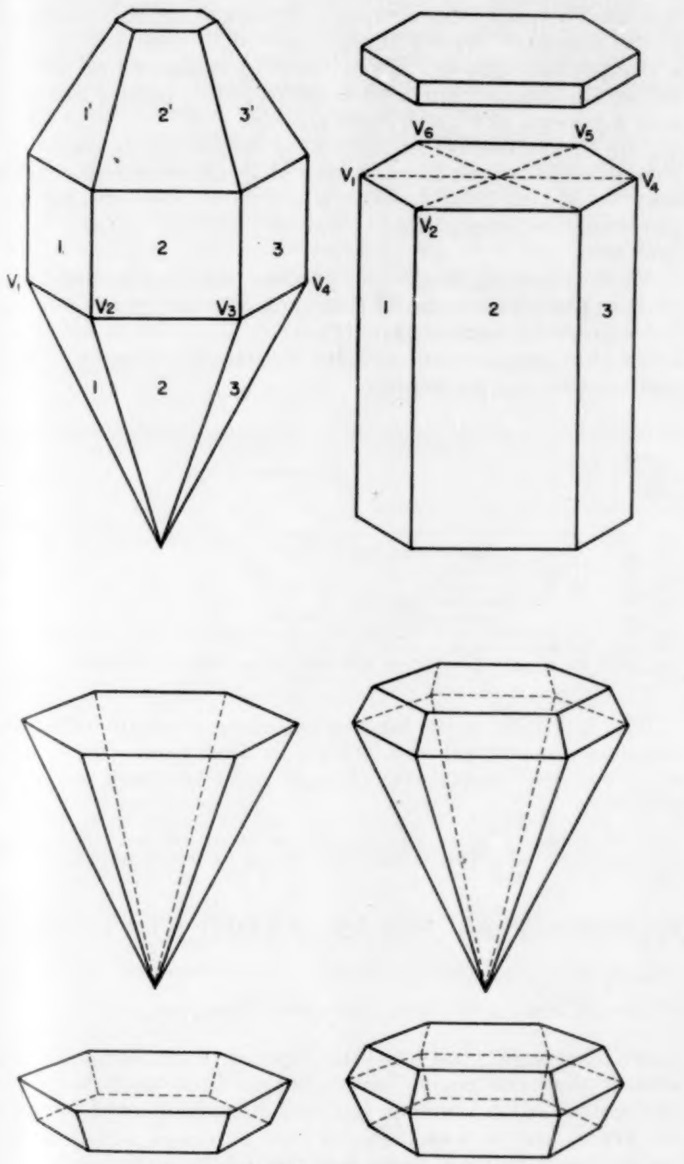


FIGURE 19.—Elementary Forms of Ice Crystals.

will be adopted here; the calculations for pyramidal crystals may easily be repeated by anyone who desires, with any other given value of this angle.

Then, in a crystal with a pyramidal element, the refracting angles through which transmission is possible (i. e., the dihedral angles less than 99°31′) are as follows (see figure 20):

[2] W. J. Humphreys, *Physics of the Air*, 3 ed., pp. 528–529, 1940; MONTHLY WEATHER REVIEW 50:535–536, 1922, and 51:255–256, 1923. *Cf.* Besson, MONTHLY WEATHER REVIEW 51:254–255, 1923.

Planes	Refracting angles	Inclination of refracting edge to principal axis
Alternate faces of same pyramid (1, 3)	76°24′	42°48′
Opposite faces of same pyramid (1, 4)	49 42	90
A pyramidal face (1) and—		
Opposite face of hexagonal prism (4)	24 51	90
Alternate face of hexagonal prism (3)	63 01	28 08
A pyramidal face and base of hexagonal prism	65 00	90
A face of one pyramid (1′) and alternate face of opposite pyramid (3)	53 58	28 08

An adequate explanation of a particular observed halo complex requires a physically probable crystal form to be found, of which a set of orientations likely to occur would have produced just the combination of arcs observed, and no others, and would consistently account for the relative intensities, details of coloring, and changes with time.

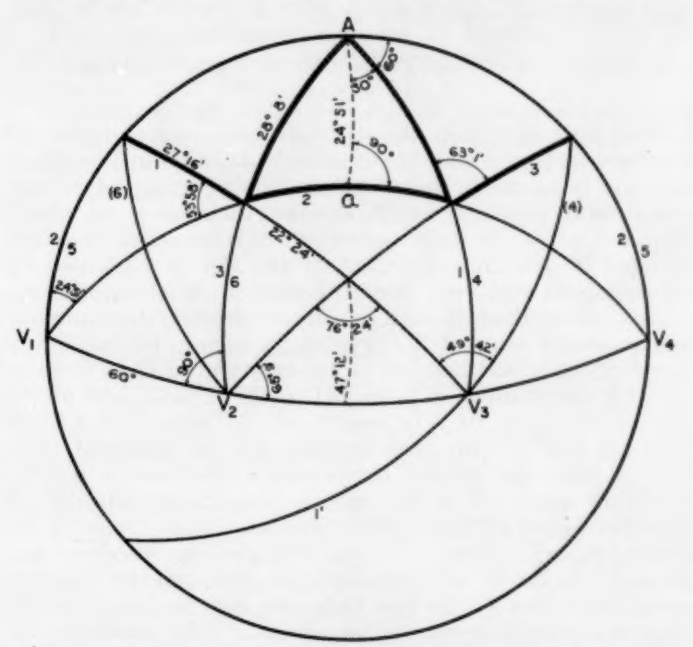


FIGURE 20.—Refracting angles in a pyramidal crystal: The figure is obtained by passing planes through the center of a sphere, parallel to the faces of a hexagonal right prism and the faces of a hexagonal right pyramid, cutting the sphere in great circles; the angles at which these circles intersect one another include all the dihedral angles formed by any two faces of any of the crystal forms in figure 19, and the points of intersection are the locations of the refracting edges. Pairs of opposite faces in the prism, or in a bipyramid, are parallel and cut the sphere in the same great circle. Given $V_1V_2 = V_2V_3 = \ldots = V_6V_1 = 60°$ and $Aa = 24°51'$, any desired arc or angle in the figure may be computed.

The present series of papers is confined to only the geometrical formation of theoretically possible halos; but it is necessary to introduce a few physical considerations as a general guide. On any occasion, there will always be some crystals in each of all geometrically possible orientations in space. At times the distribution of the crystals will be entirely random—no larger proportion in one orientation than in any other; at other times, one or more particular orientations will more or less predominate. Each separate crystal will always produce a set of images, but whether or not the aggregate effect of all the crystals in the same orientation will be distinguishable depends jointly on the number and the proportion of crystals in this particular orientation and on the relative intensity of the light transmitted and reflected by that orientation (*cf.* paper I, p. 324).

In the formal geometrical theory, we shall take into account only those orientations of each crystal form that may reasonably be expected under natural conditions to lead to sufficient concentration of light for the production of readily observable effects: that is, only orientations that (1) correspond to the minimum minimorum, or (2) predominate as a result of a restrictive influence that deprives the crystal of one of its degrees of freedom and at the same time correspond to minimum deviation, or (3) predominate because of a restrictive influence that deprives the crystal of two of its degrees of freedom, in which case all deviations must be considered. In general, only reflections that are total need be taken into account.

The different orientations that are to be taken into account in any case, for deriving the collective effect of all the crystals, may be conveniently specified by the positions in which the principal crystallographic axis may lie in space, and the extent to which rotation of the crystal may take place around the axis.

THE OPTICAL METEORS PRODUCED BY CRYSTALS ORIENTED AT RANDOM

The case in which the crystals have three degrees of freedom and are oriented completely at random—as many crystals lying with their axes in one position as in any other, and rotating freely around their axes—is easily disposed of. The only important relative concentration of light into a limited region of the sky is produced by refraction at and very near the minimum minimorum.

Any plane through the line from observer to luminary will intersect some of the crystals; a certain proportion of these crystals will happen to be so oriented that the section by the plane is a principal plane of some one of the refracting angles, or very nearly so. All rays in this plane that are incident on such crystals will be refracted in or near a principal plane; the sections themselves will be randomly oriented in the intersecting plane, so that all possible values of the angle of incidence, and hence of the deviation, will occur. Of the crystals that produce any given deviation D, all those on a line through the observer at an angle D with the line from observer to luminary will send the refracted ray to the observer; the observer will therefore see an image on the sky at an angular distance from the luminary equal to the deviation, and in a direction from the luminary on the great circle where the intersecting plane cuts the celestial sphere. The images corresponding to the different deviations in any such plane will collectively form an arc extending along this great circle from the minimum minimorum to the maximum deviation, but fading rapidly in brightness with increasing deviation. The same effect will be produced in all planes through the line from observer to luminary, all of which may be obtained by revolving a plane around this line; hence a circular ring of light will appear, centered at the luminary, with a sharp inner edge (contrasting with a comparatively dark sky within) of radius equal to the minimum minimorum, and a diffuse outer border merging into a general sky glare beyond.

The concentration of light near minimum deviation in the principal plane is so strong that these circular halos may be distinguishable even when particular orientations predominate among the crystals sufficiently to give other arcs also.

Each refracting angle can produce such a circular halo; and it is to phenomena of this type that the generic name halo properly applies (Gr., ἅλως). The radii of all these halos that can be produced by the crystal forms we have enumerated are as follows:

Refraction angle	Radius of halo	Crystal elements required
° ′	° ′	
24 51	7 54	Hexagonal prism with pyramid.
49 42	17 06	Pyramid.
53 58	18 58	Bipyramid.
60 00	21 50	Hexagonal prism.
63 01	23 24	Hexagonal prism with pyramid.
65 09	24 34	Pyramid with plane base; or bipyramid with one truncation.
76 24	31 49	Pyramid.
90 00	45 44	Hexagonal prism, with plane base or truncated pyramid.

The 22° halo is by far the commonest of all halo phenomena; nearly all the others in this table have been observed with certainty, though most of them are very rare.[3]

[3] See W. J. Humphreys, *Physics of the Air*, 3 ed., pp. 534–536, 1940, and the further references there given. *Cf.* Besson, MONTHLY WEATHER REVIEW, 42: 443, 1914, and 51: 254, 1923.

RECALIBRATION OF INSTRUMENTAL EQUIPMENT AT SOLAR RADIO STATIONS

By IRVING F. HAND AND HELEN F. CULLINANE

[U. S. Weather Bureau Solar Radiation Supervisory Station, Blue Hill Observatory of Harvard University, Milton, Mass., October 1941]

The desirability of recalibrating the equipment used at stations where records of solar radiation are now being made has long been recognized. The original calibrations of the pyrheliometers were made by three separate agencies: (1) the Solar Radiation Investigations section of the United States Weather Bureau (2) the Eppley Laboratory, and (3) the National Bureau of Standards. Calibrations by (1) were made by occulting the sun at regular intervals on clear days, subtracting the values of the sky radiation thus determined from the total radiation on a horizontal surface, and obtaining the ratio between this result and the otherwise measured value of the normal incidence radiation reduced to a horizontal surface by means of the sine law. Calibrations by (2) and (3) were obtained by direct comparison against standards furnished by the Weather Bureau. It was obvious that great improvement would be obtained if all instruments were recalibrated against a single carefully standardized pair of pyrheliometers; and the need for this increased after a more thorough study of the Eppley pyrheliometer had shown that the cosine law failed to hold with low sun.[1] Moreover, some stations had not been inspected for over 10 years, and it was thought best to check not only the pyrheliometers but also the recording equipment and other accessories.

Between March and July 1941, all stations listed in table 1 were therefore visited; the pyrheliometers were carefully leveled, where necessary, and checked against either the 10- or the 50-junction standards, which previously had been standardized directly against the standard Smithsonian silver-disk normal incidence pyrheliometer. We may now be confident that all these stations are on the same standard, and as close to the Smithsonian scale of pyrheliometry as we are able to place it. Table 1 gives the average monthly e. m. f. of all pyrheliometers checked, and also the percentage change from the mean

[1] Byron H. Woertz and Irving F. Hand. The Characteristics of the Eppley Pyrheliometer. MONTHLY WEATHER REVIEW, 69: 146–148, 1941, May.

factor formerly used. The new monthly values of e. m. f. were calculated by the formula given by Woertz and Hand,[1] but this formula was somewhat modified to take account of the fact that the variation in e. m. f. applies only when the sun is shining.

On the whole, the pyrheliometers themselves were in fairly good condition and showed less change than we had anticipated; the Madison standardization showed no appreciable change, while New Orleans had a 6.5-percent drop.

Some changes were noted in the full-scale deflections of the microammeters, and calculations made to rectify the reductions. The integrated effects of the total changes are shown in table 2, thus enabling previously published data to be brought up to date if desired.

Table 1 also lists the percentage changes in the reduction factors necessary to reduce the integrated areas to values in gram calories. It will be noted that on the whole the algebraic sign is reversed from the values appearing for the percentage change in e. m. f. because, for example, if the pyrheliometer has been found to be less efficient, naturally a larger factor will be necessary. It also will be noted that while the values for the stations utilizing potentiometers remain unchanged except for change in sign, the stations using microammeters show considerable change in values. All the potentiometers checked were adjusted so as to give their rated full-scale deflection; but this is impracticable in the case of microammeters, and it was therefore necessary to accept the current values of these latter instruments. Unfortunately, too, it has been found that microammeters have a greater tendency to vary in full-scale deflection than do potentiometers; and because of this fact, and also because the errors arising from free-air temperature changes are reduced to a minimum through the use of the null potentiometric method, the Weather Bureau is replacing microammeters with potentiometers as rapidly as funds permit.

The reduction factors for New York City showed the greatest change, 10.3 percent, whereas the standardization of the pyrheliometer gave a value only 2.4 percent higher than that formerly obtained. The remaining 7.9 percent change was owing to shift in the full-scale deflection of the recording microammeter.

The change in the equipment at Madison, Wis., was all but inappreciable, being less than one-tenth of 1 percent.

Normals for all stations where the apparatus has recently been checked were recomputed, and placed on the new standard. The values in the last row of table 1 may be used by those who desire to bring previously published data up to date. Table 2 gives complete instrumental data for the stations.

[1] Byron H. Woertz and Irving F. Hand. The Characteristics of the Eppley Pyrheliometer. MONTHLY WEATHER REVIEW, 69: 146-148, 1941, May.

TABLE 1.—New pyrheliometric standardizations[1] (Mv/gm cal/cm²)

	Albuquerque, N. Mex.		American University		Blue Hill, Mass.		Riverside, N. Y.		Chicago, Ill.		Twin Falls, Idaho		New Orleans, La.	
	New	Old	New	Old	New	Old	New	Old	New	Old	New	Old	New	Old
January	8.732		1.904		1.670		1.390		8.480		8.981		8.062	
February	8.753		1.905		1.675		1.391		8.509		9.008		8.066	
March	8.772		1.906		1.683		1.397		8.530		9.032		8.085	
April	8.806		1.912		1.688		1.400		8.539		9.070		8.099	
May	8.826		1.913		1.692		1.401		8.546		9.082		8.102	
June	8.835		1.916		1.693		1.403		8.553		9.084		8.101	
July	8.845		1.914		1.692		1.402		8.546		9.082		8.103	
August	8.826		1.912		1.690		1.402		8.543		9.075		8.100	
September	8.810		1.909		1.686		1.394		8.524		9.048		8.089	
October	8.760		1.901		1.677		1.394		8.508		9.014		8.077	
November	8.722		1.896		1.672		1.389		8.500		8.985		8.058	
December	8.702		1.892		1.671		1.389		8.500		8.993		8.051	
Mean	8.782	9.12	1.907	1.81	1.682	1.67	1.396	1.43	8.523	8.79	9.038	9.18	8.083	8.61
Percentage change from old e. m. f.	−3.8		+5.4		+.7		−2.4		−3.1		−1.6		−6.5	
Percentage change in reduction factors	+.7		−5.4		−.7		+3.4		+3.3		+ .5		+6.5	

	La Jolla, Calif.		Fresno, Calif.		Lincoln, Nebr.		Madison, Wis.		New York		State College		Cambridge, Mass.	
	New	Old	New	Old	New	Old	New	Old	New	Old	New	Old	New	Old
January	7.576		7.160		1.386		1.874		5.584		0.521		8.370	
February	7.595		7.120		1.395		1.876		5.596		.510		8.202	
March	7.622		7.203		1.399		1.880		5.629		.509		8.185	
April	7.646		7.218		1.401		1.884		5.641		.501		8.068	
May	7.656		7.227		1.403		1.887		5.653		.501		7.995	
June	7.660		7.230		1.404		1.889		5.658		.500		8.036	
July	7.656		7.224		1.403		1.888		5.657		.500		8.034	
August	7.653		7.215		1.402		1.884		5.649		.501		8.065	
September	7.630		7.206		1.398		1.880		5.632		.504		8.094	
October	7.606		7.174		1.394		1.877		5.614		.506		8.140	
November	7.572		7.154		1.389		1.875		5.590		.518		8.318	
December	7.554		7.152		1.388		1.874		5.580		522	(1)	8.396	
Mean	7.619	8.37	7.190	7.02	1.397	1.37	1.881	1.88	5.624	5.49	5.08		8.159	8.516
Percentage change from old e. m. f.	−10.0		+2.4		+2.0		0		+2.4				−4.4	
Percentage change in reduction factors	+4.2		−1.9		−2.9		0		−10.3				+4.4	

[1] New station.

TABLE 2.—*Instrumental data*

Station	Under direction of—	Eppley pyrheliometer number	E. m. f. per gram-calorie, mv.	Resistance, ohms	Registers	Resistance, ohms	Full-scale deflection	Notes
1. Fairbanks, Alaska	U. S. Weather Bureau	235	7.46	84.8	Engelhard	151	30 ma	Number unknown. (C. I. C.)
2. Lincoln, Nebr	do	296	1.386-1.404	32.0	Leeds & Northrup		4 mv	Normal incidence also. (C. I. C.)
3. Madison, Wis	do	359	1.874-1.889	36.0	do		4 mv	Do.
4. New York, N. Y	do	191	5.580-5.658	84.2	Engelhard, 30749	137	27.8 ma	Register needs replacing. (C. I. C.)
5. Washington, D. C	U. S. Weather Bureau, American University.	447	1.892-1.916	37.0	Bristol, model 527, serial 567		4 mv	Dr. E. W. Engel.
6. Albuquerque, N. Mex	U. S. Weather Bureau, airport	316	8.702-8.845	113.0	Engelhard, 27346	132	28.6 ma	Engelhard soon to be replaced with potentiometer.
6a. Albuquerque, N. Mex	do	656	1.429		Leeds & Northrup			(Should be installed by end of 1941.)
7. Fresno, Calif	U. S. Weather Bureau	223	7.160-.7230	82.8	Engelhard, 26209	134.3	30.8	Excellent station.
8. Chicago, Ill	do	358	8.480	111.0	Engelhard, 27273	139.5	50.4	Engelhard needs replacing.
9. Bismarck, N. Dak	do							Station to be opened shortly.
10. Nashville, Tenn	do							Do.
11. Miami, Fla	do							Do.
12. San Juan, P. R	U. S. Weather Bureau, Puerto Rico.	445	1.90	36.0	Modified potentiometer			Dr. G. W. Kenrick.
13. Ithaca, N. Y	Cornell University	295	1.813	30.0	Leeds & Northrup			Dr. A. J. Heinicke, department of pomology.
14. Riverside, Calif	University of California	301	1.389-1.403	34.0	Engelhard, 30749	172	14.7 ma	Dr. E. R. Parker, citrus station.
15. Twin Falls, Idaho	U. S. Bureau of Plant Industry.	386	8.981-9.084	111.0	25166	129.7	28.9 ma	Station in very poor shape—should have new instruments.
16. Blue Hill, Mass	Harvard	498	1.670-1.693		Leeds & Northrup, 251588		2.8 mv	Alternate recorders now and then. Dr. Charles F. Brooks.
17. State College, Pa	State College	(?)	0.662	(?)	Leeds & Northrup circular sheets.			Dr. H. Landsberg. Pyrheliometer has had new cover; very inefficient outfit.
18. New Orleans, La	Tulane University	(?)	8.051-8.103	(?)	Leeds & Northrup, 80 div., ½ hour lines.		16.0 mv	Dr. Henry Laurens.
19. La Jolla, Calif	Scripps Institute of Oceanography, University of California.	335	7.554-7.656		Englehard		30.8 ma	Dr. George F. McEwen.
20. Torrey Pines, Calif	U. S. Bureau of Plant Industry.	518	8.035-8.112		Leeds & Northrup		16. mv	Dr. L. A. Richards.
21. Indio, Calif	do	519	7.903-7.968		do		16 mv	Dr. L. A. Richards or Dr. Aldrich.
22. Washington, D. C	National Bureau of Standards	387	8.36		do		(?)	Pyrheliometers need restandardizing. 50-junction.
23. Washington, D. C	do	393	1.88		do		(?)	10-junction.
24. Friday Harbor, Wash	University of Washington, Seattle, Wash.	262	8.71		Engelhard			Dr. C. L. Utterback. Suggested that they have their pyrheliometer leveled. No reply.
25. Newport, R. I	Eppley Laboratory	362 489 389 391	1.589 1.382 7.685 7.960		Various potentiometers			Mr. Roy Anderson, Manager, or Mr. William R. Gray.
26. Cambridge, Mass	Massachusetts Institute of Technology.	434	8.52		Leeds & Northrup			Dr. Hoyt C. Hottel.

TROPICAL DISTURBANCES OF SEPTEMBER 1941

By HOWARD C. SUMNER

[Weather Bureau, Washington, October 1941]

The first tropical disturbance of the 1941 hurricane season appeared in the northern Gulf of Mexico on the evening of September 11. This is the first time in over 25 years that the North Atlantic area has been free from tropical disturbances until so late in the season. Annual records, from 1887 to the present time, show that only on two other occasions have tropical storms failed to develop before the 11th of September. In 1907 and 1914 the first tropical disturbances of the season were observed on September 16 and September 14, respectively.

After the unusually late start, four disturbances developed in rapid succession, between September 11 and 23, two of which were accompanied by winds of full hurricane force. The last three of these disturbances were in progress at the same time, with advisories being issued simultaneously by the supervising centers at Washington, New Orleans, and San Juan.

September 11–15, 1941.—A Gulf disturbance of slight intensity appeared on the morning of September 11, and was centered at 7 a. m.[1] about 120 miles southeast of Port Eads, La. The center moved very slowly in a west-northwesterly direction toward the north Texas coast and moved inland, between Galveston and Port Arthur, the night of September 14–15, resulting in a series of squalls at Port Arthur.

The lowest barometer reported during the short 5-day course of this storm, 1,002.7 millibars (29.61 inches), accompanied by a force 8 wind (Beaufort scale), came from a ship near 28°06′ N., 90°18′ W., on September 13.

On the coast the highest wind velocity registered was 31 miles per hour from the east at Port Arthur and the lowest barometer 1,007.5 millibars (29.75 inches) at 4:30 p. m. (C. S. T.) on the 14th at the same station. Rainfall for the 2-day period (14–15) at Port Arthur was 1.52 inches.

This disturbance was sufficiently threatening on the 13th for warnings to be issued to people in low-lying areas; but during the last 24 hours before it crossed the coast it decreased greatly in intensity and no property damage or injuries were reported.

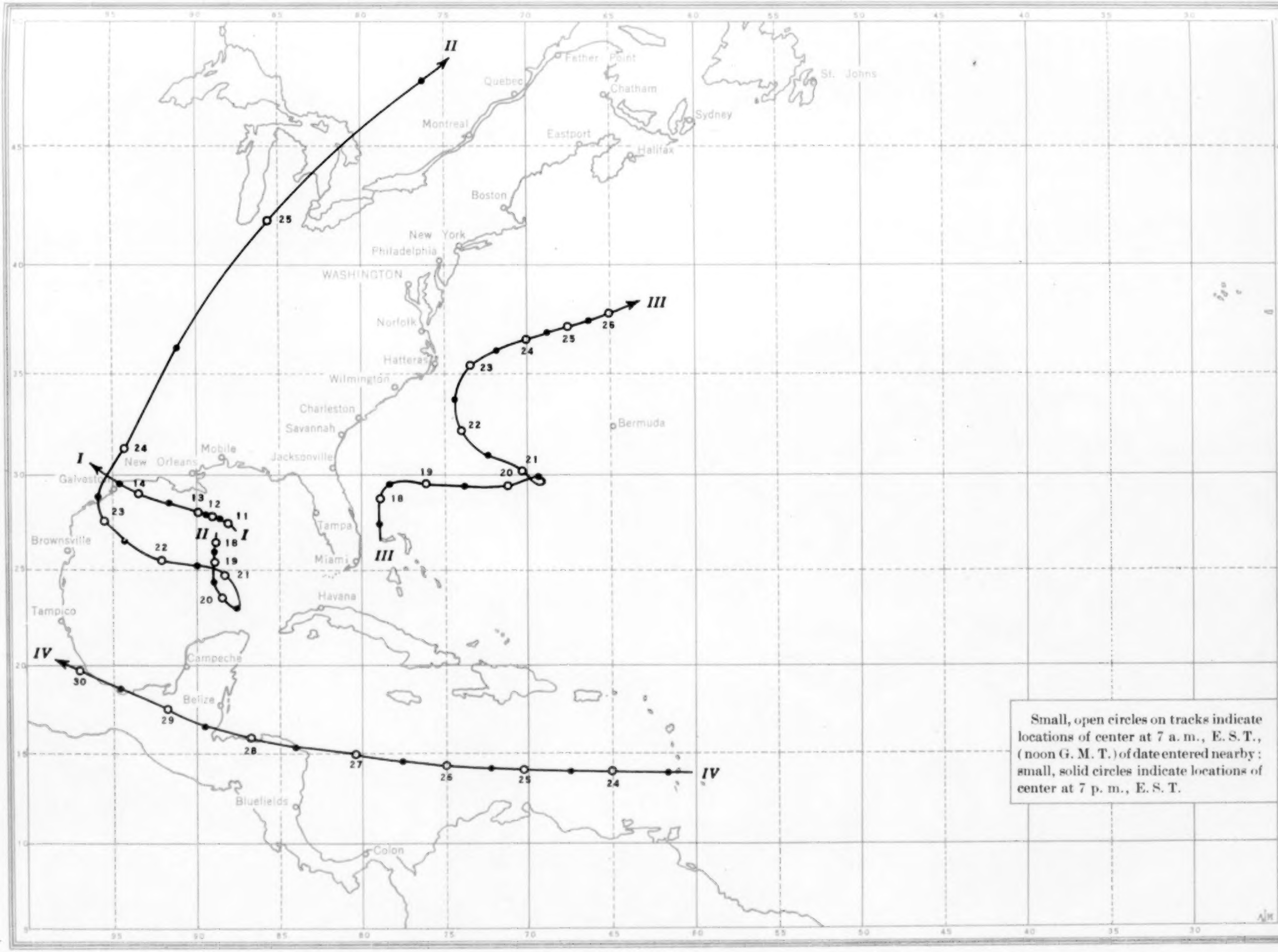
September 18–26.—This hurricane was first noted as a disturbance of slight intensity about 180 miles south of Port Eads, La., on September 18. For 48 hours the center drifted gradually southward toward the Yucatan coast with winds increasing to gale force. During the night of September 20–21 the storm turned, and moving northward retraced its path until, on the evening observation of the 21st, it was again near the region where first detected. It then took a northwestward course through the western Gulf of Mexico and moved inland on the Texas coast near Matagorda at 3:25 p. m. (C. S. T.) on September 23.

A ship near 27°06′ N., 93°42′ W., on September 22 reported a northeast wind, force 12, and a low barometer reading of 985.8 millibars (29.11 inches).

On the coast, Texas City reported the highest recorded

[1] Times mentioned are E. S. T. unless otherwise indicated.

Tracks of North Atlantic Tropical Storms, September 1941



wind velocity, 83 miles per hour. Estimated winds up to 100 miles per hour came from several points nearer the storm center.

The following excerpts from a report by G. P. Rusmisel, of the Galveston office, relate to conditions at that station during the approach and passage of the storm:

> There was little characteristic sky appearance prior to the advent of the storm, the sky being mostly clear until lower clouds appeared suddenly between 6 and 7 a. m. C. S. T., on the 22d with alto-cumulus and alto-stratus overcast showing through breaks occasionally during the day. By late afternoon of the 22d the sky became completely overcast with low clouds of bad weather which predominated throughout the remainder of the storm. * * * Tides had been somewhat above normal at Galveston since the minor disturbance of September 11–15 and began to rise again on the 21st, and more rapidly to a crest of 6.7 feet at 8 p. m. and 10 p. m., C. S. T. on the 22d, then falling to 5.0 feet at 1 p. m. of the 23d. Tides rose again thereafter to a crest of 7.0 feet at 9 and 10 p. m. C. S. T. on the 23d, after which they subsided rapidly. * * *
>
> The sea was rather light at about 10 swells per minute until the storm moved toward the Texas coast, after which an increase set in becoming very heavy and reaching 5 swells per minute at the height of the storm. * * *
>
> Tidewater covered all of the Galveston Island beaches, much of the island beyond the seawall, and entered the lower residential and business sections as backwater from the bay. * * * Tidewater also covered the municipal airport to a depth of approximately 1 to 3 feet and was about 6 inches deep on the floor of the airport administration building and in the C. A. A. communications station room, putting that office out of commission until after the water receded and power and telephone service was restored the evening of the 25th.

Recurving to the northeastward after crossing the Texas coast the storm center passed slightly west of Houston. The lowest pressure registered along the path of the hurricane, 970.5 millibars (28.66 inches), was observed at Houston Airport at 11:08 p. m. of the 23d. The passage of the low pressure was accompanied by winds estimated at 75 miles per hour; a recorded velocity becoming impossible because of power failure.

Progressive movement of the storm increased rapidly as the center moved up the Mississippi Valley and passed over the Canadian boundary in the Lake region.

Available sources estimate property damage at well over $2,000,000. The rice crop in the region affected was ruined, and has been estimated as a loss of $4,000,000. About 25 to 30 percent of the cotton crop had been picked in this section. Half of that remaining in the fields has been reported lost.

Warnings on this storm were given the widest possible dissemination by radio, press, telegraph, and telephone. As a result of these warnings an estimated 25,000 persons left their usual place of abode for safer surroundings. The smaller towns along the coast were practically deserted. It is noteworthy that, so far as is known, only four lives were lost, either directly or indirectly, as a result of this storm which traversed a low-lying region where without warning thousands would have been left to the mercy of wind and tide.

September 18–26.—On the morning of the 18th, disturbed conditions and squally weather were observed over the Atlantic east of Florida, with indications of a center of circulation about 150 miles east of Titusville. During the 18th this disturbance moved in a direction slightly north of east with highest wind, force 7, reported in squalls. It then curved sharply to the eastward and by the morning observation of the 20th appeared as a very large elongated low pressure area extending from the Bahamas to Bermuda with center about latitude 29°30′ N., longitude 71°00′ W. During the night the center executed a right-hand loop and headed northwestward toward the North Carolina coast.

Along the path of this storm from September 20 to 23 several ships reported winds force 11, with the lowest barometer observed, during this period, 995.3 millibars (29.39 inches) at 30°00′ N., 70°10′ W. on September 20.

A ship bound from Curacao to New York had two encounters with this storm; first near 30°11′ N., 71°45′ W. on the morning of September 20, when at 4 a. m. a low barometer of 1,006.4 millibars (29.72 inches) was recorded, and again 2 days later near 34°13′ N., 75°09′ W., with the barometer falling to 1,004.7 millibars (29.67 inches) at 8 p. m. on September 22. During the interval between these observations the center of the storm, which during the first encounter had been moving eastward south of the vessel, turned in its track and overtook the ship from the southeast (track III, chart 1). Force 8 winds were encountered on both occasions.

Late on the 22d the storm recurved to the northeastward in about 33°30′ N., 74°00′ W., passing about 150 miles east of Hatteras, and dissipated in the western North Atlantic on the 26th.

This storm did not develop hurricane intensity but was attended by strong winds and gales which caused considerable delay in North Atlantic shipping.

Timely small craft warnings kept small boats along the coast out of danger. No destructive winds occurred on land.

September 23–30.—This storm was first noticed as a very slight disturbance about 75 miles northwest of Barbados in the early afternoon of September 23. Moving almost due west it passed slightly south of St. Lucia and into the Caribbean Sea, where it quickly developed hurricane intensity.

On the morning of the 25th the hurricane-buffeted freighter m. s. *Ethel Skakel* flashed a "sinking" message from 125 miles north of Aruba, Dutch West Indies, and later went down with her cargo of steel rails near 14° N., 70° W. Of the crew of 33 men, only 13 were reported rescued, the other 20 being presumably lost.

Two other vessels sent distress signals from locations near the path of the storm, one of which was later reported lost with her entire crew of 27 men.

Taking a course slightly north of west the storm then moved across the western Caribbean and by the morning observation of the 27th was centered in the vicinity of Cape Gracias, Nicaragua.

Through the courtesy of Jose Carlos Millas, Director of the National Observatory at Havana, Cuba, the following report has been received:

> Today (October 1), we have been able to establish contact with Cape Gracias. The town was destroyed and our station is practically lost. As I had advised the Governor that the hurricane would pass through that place the day before, all the people fled, except 11, of which 3 were drowned. The observer stayed until 9:45 a. m. (of the 27th), at which time he sent his last message. The observation building also came down. The sea flooded the town, reaching a height of about 2 meters, wrecking everything there. The inhabitants have come back to what is left of the place.

From Cape Gracias the hurricane moved with slightly increased speed across extreme northern Honduras, passing into the Gulf of Honduras, near La Ceiba, about 9 a. m. (local time) of the 28th, with lowest barometer reported 992.9 millibars (29.32 inches), and still accompanied by winds of hurricane force. A vessel, located 16 miles north of Ceiba, reported winds estimated at 100 miles per hour, after passage of the center. The storm moved inland again over the coast of British Honduras, about 70 miles south of Belize, during the afternoon of the 28th, and 24 hours later emerged into the Bay of Campeche. Continuing to move west-north-

westward the disturbance decreased rapidly in intensity as it approached the Mexican coast, and moved inland, for the third time, as a weak depression near Vera Cruz on September 30.

Complete information regarding loss of life and property damage for this storm is not available at this time, but since it was of hurricane intensity, damage in the Central American countries affected was probably severe.

The tracks of these tropical disturbances of September 1941 are shown on the accompanying chart.

NOTES AND REVIEWS

W. E. KNOWLES MIDDLETON. **Visibility in Meteorology.** 2nd Edition. Toronto (University of Toronto Press), 1941. 165 pp., 32 figs.

The second edition of this monograph is a comprehensive summary on the theory and practice of the measurement of the visual range. It is still the only book devoted wholly to this subject which, in some respects, has been neglected in this era of expanded transport.

The concisely and carefully written theoretical portions of the first edition have been largely retained in this new issue, with some small improvements in notation, and several important brief additions. Among the topics discussed in the new material are the following: Variation of the extinction coefficient with visual range and with size of water droplets, for different colors; nature of atmospheric aerosols; properties of the eye in the light- and dark-adapted states; and visual range in fog, and its relation to water content.

The "practical" part of the first edition has been superseded by a largely rewritten version. In connection with this, a variety of telephotometers and transmission meters for measuring the atmospheric extinction coefficient are described. Great expansion in scope of the chapter relating to the estimation of the visual range in practice has enabled the author to present a comparative discussion on various visibility scales, a matter of considerable interest to those concerned with the technique of making observations for airway and synoptic reports.

A new chapter on "Forecasting the visual range," and a new appendix on "The visual range of coloured objects" contain material of great practical and theoretical importance.

Revision of the book has increased its size by 61 pages, and the number of figures by 23. The extensive bibliography on visibility and pertinent additional topics given in the work now covers 342 items.—L. P. H.

SVERRE PETTERSSEN. **Introduction to Meteorology.** New York (McGraw-Hill Book Co.), 1941. ix, 236 pp., 142 figs.

This book is intended as an elementary introduction to general meteorology, for students without previous knowledge of the subject. No mathematics beyond an occasional simple algebraic formula is used; and the elementary physics involved is explained in the text. The emphasis is on synoptic and aeronautical meteorology; but nearly all the more important topics of meteorology proper (i. e., exclusive of optical, electrical, and acoustic phenomena of the atmosphere) are at least briefly discussed.

The opening chapters describe the general nature and structure of the atmosphere, and the principal types of meteorological observations and instruments. A chapter is then devoted to evaporation, condensation, and precipitation, followed by two chapters on adiabatic processes in the atmosphere and atmospheric stability. The next chapter discusses the processes by which transfers of heat and changes of temperature are brought about in the atmosphere, and some of their effects—including modification of lapse rates, occurrence of convection, thunderstorms, fog formation, and ice accretion on airplanes.

A chapter on atmospheric circulation—winds, their relation to pressure distribution and their variation with height; the planetary circulation; turbulence; etc.—is followed by two chapters on air masses and fronts, and a chapter on cyclones (extratropical and tropical) and anticyclones, with a brief allusion to tornadoes and waterspouts. The next three chapters are devoted to the drawing and analysis of synoptic maps, and the forecasting of weather, in accordance with the most recent methods, illustrated by a number of actual examples.

The book concludes with a chapter on climate and the climates of the earth, and one on the history of meteorology. A list of recommended books for further reading, a few short tables, and an index are appended.

METEOROLOGICAL AND CLIMATOLOGICAL DATA FOR SEPTEMBER 1941

[Climate and Crop Weather Division, J. B. KINCER in charge]

AEROLOGICAL OBSERVATIONS

By HOMER D. DYCK

Surface temperatures for September were above normal generally over the eastern half of the country and below normal over the western half with the exception of a strip along the Pacific coast which recorded above normal warmth. Plus departures of from 4° to 6° F. were recorded in the southern Lake region, the Ohio Valley and Tennessee and the Middle Atlantic States, while minus departures of from 4° to 6° F. were recorded in the Great Basin.

At 1,500 meters above sea level the 5 a. m. resultant winds for September were from directions to the south of normal over most of the country east of the Rocky Mountains and north of normal at this level over the rest of the country. At 3,000 meters the morning resultant winds were more northerly than normal along the Middle and North Atlantic coast and west of the Rocky Mountains and more southerly than normal elsewhere. At the 5,000 meter level, a comparison of the 5 p. m. resultant winds for September with the 5 a. m. normals shows that the late afternoon resultants were more southerly than the corresponding morning normals at about half of the stations for which these data could be compared.

It is interesting to note that the above-normal temperatures in the eastern half of the country were accompanied by more southerly than normal wind resultants generally and the below normal temperatures in the West coincided with more northerly than normal resultants. Exceptions to this correspondence are the strips along each coast.

Resultant wind velocities at 1,500 meters were above normal over most of the country with the exception of the southern Plateau region and the Middle Atlantic States, where they were slightly below normal. At 3,000 meters resultant velocities were above normal except over the Middle and South Atlantic States, while at 5,000 meters the 5 p. m. resultant velocities were higher than the corresponding 5 a. m. normals over the same regions.

At 1,500 meters the 5 p. m. resultant winds for the

month were from more southerly directions than were the corresponding 5 a. m. winds generally with the exception of a few scattered stations in the Gulf States. At 3,000 meters a turning to southward during the day was noted over the northern half of the country with the exception of the Northeast and the Northwest, where, as in the southern half of the country, the opposite shift was noted during the day.

The 5 p. m. resultant velocities at 1,500 meters were lower than the corresponding 5 a. m. velocities over the eastern half of the United States with the exception of areas along the Middle and South Atlantic coasts while they were higher over the western half with the exception of California. At 3,000 meters the afternoon velocities were higher generally than the corresponding morning velocities except in Florida and parts of the Great Plateau, where they were lower.

The upper-air data discussed above are based on 5 a. m. (E. S. T.) pilot balloon observations (charts VIII and IX) as well as on observations made at 5 p. m. (table 2 and charts X and XI).

Radiosonde and airplane stations located in the southern part of the country recorded on the average the highest daily pressures at each of the standard levels from 2,000 meters to 18,000 meters. The highest mean monthly pressure at the 2,000 meter level occurred over Atlanta, Charleston, Nashville, Norfolk, and Washington, D. C.; over Atlanta and Charleston at 2,500 meters and over Atlanta from 3,000 to 6,000 meters, inclusive. A similar maximum was also recorded over San Antonio and Nashville at 6,000 meters. At each level from 7,000 to 18,000 meters, inclusive, San Antonio recorded the maximum pressure. At 17,000 meters, however, two other stations, Nashville and Washington, also recorded the maximum and at 18,000 meters, Nashville, Phoenix, San Diego, and Washington also recorded the maximum. Great Falls recorded the minimum pressure at 2,000 meters, Spokane and Great Falls the minimum at 2,500 meters, and Spokane the minimum at 3,000 meters. At 4,000 meters Great Falls, Seattle, and Spokane recorded the minimum while from 5,000 to 7,000 meters, Seattle and Spokane recorded the minimum. At all standard levels from 8,000 to 18,000 meters, inclusive, the minimum pressure occurred over Spokane.

With but few exceptions, mean pressures for September were lower than those for August over most stations west of the Mississippi River and over Florida at most levels up to and including 19,000 meters. The decrease in mean pressure was quite marked over the northern Plateau region, amounting to as much as 12 millibars over Great Falls at 7,000 meters. In the lower levels up to and including 3,000 meters, the area over which pressures averaged above August's included the eastern Lake Region, Ohio Valley and Tennessee, and the Atlantic States, excluding Florida. At higher levels from 5,000 to 13,000 meters, the area of higher pressures decreased to include only the eastern Lake region, and the Middle and North Atlantic States. Above 13,000 meters pressures averaged near August's over most of the country east of the Mississippi River. Pressure gradients this month were not as steep along the Atlantic coast but were steeper in the Northwest than during the preceding month. The steepest upper level pressure gradient for September occurred at the 8,000, 11,000 and 12,000 meter levels between Sault Ste. Marie and Detroit. At these levels there was a change of 1 millibar pressure for each 38 miles of horizontal distance between these two cities.

Mean free-air temperatures for September were generally lower than those for August for most stations in the United States up to and including 11,000 meters. Notable exceptions to this generalization, however, were temperatures higher than August's over the eastern Lake region, the North and Middle Atlantic States, the Florida Peninsula, and southern Texas from about 2,000 meters to about 11,000 meters. Above 11,000 meters, temperatures were above August's over the Plateau and generally lower over the remainder of the country. The decreases from last month's temperatures were most pronounced over the northern Plateau region where decreases of 8° to 9° C. were recorded in the lower levels. At three stations, Medford, Oreg., St. Louis, Mo., and Huntington, W. Va., free-air temperatures were lower than last month at all levels.

When temperatures for September 1941 are compared with temperatures for September 1940, it may be seen that from levels up to and including 11,000 meters, the temperatures this month averaged lower than those of a year ago over much of the Plateau region and the far Northwest and higher than those of a year ago over the remainder of the country. Above 13,000 meters these conditions were almost reversed.

Mean temperatures for September at both the 1,000 and 3,000 meter levels were above normal over the eastern half of the country and below normal elsewhere. At 5,000 meters the area of above-normal temperatures increased in extent to include the southern Plateau region and most of the Great Plains area with below-normal temperatures over the remainder. Plus departures were most pronounced over the Middle West and minus departures most pronounced in the far Northwest.

Relative humidities at 1,000 meters averaged above normal over the far Northwest, the Great Plains and the Lake region, and slightly below normal elsewhere. At 3,000 meters humidities were decidedly above normal over the far Northwest, and somewhat above normal over the Rocky Mountain region and the Great Plains, with somewhat below normal humidities elsewhere. At 5,000 meters the northern third of the country and the extreme southern part recorded above normal humidities while the remainder recorded below-normal humidities.

The altitude at which the mean monthly temperature of 0° C. for September occurred, varied from the lowest (2,500 meters) over Seattle, Wash., to the highest (5,200 meters) over San Antonio, Tex. The level at which, on the average, freezing conditions occurred was lower than last month generally except over Texas, Florida, the Lake Region, and the Northeast where it was slightly higher. This level was decidedly lower than last month over the far Northwest and the northern Plateau region, being 1,300 meters lower over Great Falls, Mont.

The lowest free-air temperature recorded during the month over the United States was −85.8° C. (−122° F.). This temperature occurred over San Antonio on the morning of September 3, at an altitude of 16,800 meters (about 10.4 miles) above sea level. The lowest temperature for the month over San Juan was −83.0° C. (−117° F.) which was observed at 16,800 meters (about 10.4 miles) above sea level on the afternoon of September 25.

Table 3 shows the maxima free-air wind velocities and their directions for various sections of the United States during September as determined by pilot balloon observations. The highest observed wind velocity for the month was 70.4 m. p. s. (157 miles per hour) observed over Reno, Nev., on September 11. This wind was blowing from the west-southwest at an elevation of 10,910 meters (about 6.8 miles) above sea level.

The highest September wind velocity observed during the last 5 years in the free-air layer from the surface to

2,500 meters was 48.6 m. p. s. (109 miles per hour) observed on September 19, 1941, over Modena, Utah (see table 3). The wind velocity of 55.0 m. p. s. (123 miles per hour) over Ely, Nev., on September 18, this year (see table 3) was the highest observed in the layer from 2,500 meters to 5,000 meters, while during this 5-year period, a still higher wind velocity, 78.0 m. p. s. (174 miles per hour) was observed in September in the free air above the 5,000 meter level. This wind was observed on September 12, 1940 over San Antonio, Tex., and was blowing from the west-northwest at an elevation of 21,230 meters (about 13.2 miles).

TABLE 1.—*Mean free-air barometric pressure in millibars, temperature in degrees Centigrade, and relative humidities in percent, obtained by airplanes and radiosondes during September 1941*

Altitude (meters) m. s. l.	Stations with elevations in meters above sea level																											
	Albuquerque, N. Mex. (1,620 m.)				Atlanta, Ga. (300 m.)				Bismarck, N. Dak. (505 m.)				Boise, Idaho (894 m.)				Brownsville, Tex. (6 m.)				Buffalo, N. Y. (221 m.)				Charleston, S. C. (14 m.)			
	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity
Surface	31	837	19.0	48	31	985	22.0	77	31	953	12.2	79	29	914	13.2	52	31	1,012	26.3	87	30	992	16.0	76	31	1,017	22.1	90
500					31	963	22.7	66									31	957	24.8	86	30	961	17.1	66	31	962	22.1	77
1,000					31	909	20.0	68	31	898	13.4	65	29	900	15.7	50	31	904	22.2	80	30	906	14.8	64	31	908	19.4	72
1,500					31	858	16.8	72	31	846	11.0	64	29	848	13.9	47	31	853	19.2	76	30	854	12.3	61	31	857	16.6	66
2,000	31	801	18.1	46	31	808	14.6	66	31	797	8.5	61	29	799	10.2	49	31	804	16.4	70	30	804	10.5	53	31	808	14.3	60
2,500	31	755	14.8	48	31	762	12.0	61	31	750	6.0	58	29	752	6.5	52	31	758	13.9	63	30	757	8.5	46	31	762	12.1	48
3,000	31	712	11.4	53	31	718	9.6	54	31	705	3.2	58	29	707	2.9	56	31	715	11.4	59	30	712	6.4	38	31	717	9.5	43
4,000	30	631	4.1	62	30	636	4.4	45	30	623	−3.0	60	29	624	−3.8	59	31	634	6.2	55	29	630	1.8	32	31	635	4.2	37
5,000	28	557	−2.1	63	30	562	−1.0	38	30	548	−9.2	58	29	550	−10.0	55	31	561	0.5	51	29	556	−3.5	30	31	561	−1.3	34
6,000	29	490	−8.1	52	30	495	−7.0	35	29	481	−15.8	56	29	482	−16.7	52	31	494	−5.2	45	28	489	−9.4	27	31	494	−7.3	32
7,000	29	431	−14.3	40	30	435	−13.7	34	29	421	−22.6	56	29	421	−23.3	50	31	435	−11.6	42	26	429	−16.3	24	31	434	−13.9	31
8,000	29	377	−21.4	38	30	380	−20.8	32	29	366	−29.3	54	25	367	−30.4	48	31	381	−18.3	40	26	375	−23.3	23	31	380	−21.0	31
9,000	29	328	−28.4	36	30	331	−27.9	33	29	317	−36.4	51	24	318	−37.5	47	31	332	−25.6	38	26	326	−30.3	24	31	331	−28.5	31
10,000	29	285	−35.3	35	28	288	−35.1	31	29	274	−43.3		23	274	−44.2		30	289	−32.9	36	26	283	−37.1	23	31	288	−36.2	31
11,000	28	247	−42.4		28	249	−42.4		29	236	−48.5		22	236	−49.3		30	250	−40.8		26	244	−44.4		31	248	−43.8	
12,000	28	212	−49.1		28	214	−49.3		28	202	−51.8		20	203	−51.6		29	215	−48.7		23	209	−51.1		31	213	−51.1	
13,000	25	182	−55.6		27	184	−55.9		28	173	−53.9		20	173	−52.4		29	185	−56.5		22	179	−56.9		29	183	−57.8	
14,000	25	155	−61.1		26	157	−61.9		28	148	−55.5		19	148	−53.6		29	157	−64.2		21	152	−61.7		29	156	−64.2	
15,000	23	132	−65.3		26	133	−66.9		29	126	−57.0		19	127	−55.2		29	134	−70.9		20	130	−64.9		28	132	−68.8	
16,000	22	112	−67.6		26	113	−70.0		28	108	−57.4		19	109	−56.0		26	113	−75.0		19	110	−65.7		28	112	−70.9	
17,000	19	94	−67.0		24	95	−70.4		26	92	−56.6		16	93	−55.7		23	95	−75.0		17	93	−64.2		25	94	−70.5	
18,000	15	80	−64.6		23	80	−67.6		24	78	−55.7		12	79	−54.7		12	80	−71.8		15	78	−62.0		20	80	−66.9	
19,000	8	68	−61.6		12	68	−64.3		15	67	−54.6						6	68	−67.4		10	66	−59.2		11	68	−63.1	
20,000	5	58	−58.9						6	57	−53.4										6	56	−57.0					

Altitude (meters) m. s. l.	Stations with elevations in meters above sea level																											
	Denver, Col. (1,616 m.)				Detroit, Mich. (194 m.)				El Paso, Tex. (1,193 m.)				Ely, Nev. (1,908 m.)				Great Falls, Mont. (1,128 m.)				Huntington, W. Va. (172 m.)				Joliet, Ill. (178 m.)			
	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity
Surface	31	837	13.6	62	31	994	15.7	82	30	881	21.4	66	31	808	9.3	40	30	885	9.9	67	31	999	17.7	86	29	996	17.5	80
500					31	960	18.0	70													31	962	20.6	64	29	959	19.0	64
1,000					31	905	16.0	66													30	908	18.4	62	29	905	16.7	65
1,500					31	853	14.2	63	30	850	20.9	63					30	846	9.4	62	30	856	15.8	62	29	853	14.1	67
2,000	31	800	15.4	62	31	804	12.7	53	30	802	17.9	63	31	799	11.8	39	30	796	6.1	63	30	807	13.9	52	29	804	12.0	64
2,500	31	753	12.3	50	31	757	10.5	44	30	756	14.5	64	31	752	10.3	39	30	749	2.7	65	30	760	11.5	48	29	757	9.8	58
3,000	31	709	8.9	51	31	713	7.8	39	30	713	10.9	65	31	708	6.5	40	30	704	−.5	66	30	716	8.8	46	29	712	7.3	53
4,000	29	628	2.1	52	31	631	2.7	33	30	632	4.6	66	31	626	−.9	40	30	620	−6.8	64	29	634	3.8	40	28	630	2.1	45
5,000	29	554	−5.1	52	31	557	−2.9	28	30	558	−.9	59	31	552	−7.1	37	30	545	−12.7	61	29	560	−1.1	31	28	556	−3.3	41
6,000	29	488	−11.3	44	31	490	−8.7	24	30	492	−6.9	55	31	484	−13.8	36	30	477	−19.5	56	29	493	−7.6	26	28	490	−9.0	36
7,000	29	428	−18.0	40	30	430	−15.1	21	28	432	−13.5	50	31	425	−20.9	35	30	416	−26.3	53	29	433	−14.4	25	28	430	−15.5	34
8,000	29	373	−25.4	37	30	376	−22.1	22	28	378	−20.5	47	31	370	−28.4	34	30	362	−33.6	54	29	379	−21.2	24	28	376	−22.2	34
9,000	28	324	−33.1	35	29	327	−29.1	22	28	329	−27.5	47	31	320	−35.6	34	30	313	−41.3		28	330	−28.3	23	28	327	−29.4	33
10,000	25	281	−40.1		28	284	−35.9	23	27	286	−34.5	48	31	277	−42.8		30	270	−47.6		28	286	−35.4	20	26	284	−36.4	31
11,000	20	242	−46.5		28	246	−42.9		27	247	−42.2		29	239	−48.4		30	232	−52.2		27	248	−42.8		26	245	−43.4	
12,000	19	208	−51.7		27	212	−49.6		27	213	−49.5		29	205	−53.1		30	198	−52.8		25	212	−50.0		21	211	−49.9	
13,000	17	178	−56.3		26	181	−55.6		26	182	−56.6		29	175	−55.9		30	170	−52.6		23	182	−56.6		21	181	−56.0	
14,000	16	152	−60.6		25	155	−60.2		25	155	−63.6		29	150	−58.0		29	145	−53.1		23	155	−62.5		19	154	−61.3	
15,000	16	129	−63.3		23	131	−63.8		24	131	−66.5		26	127	−59.6		29	124	−53.8		23	132	−66.6		19	131	−65.0	
16,000	15	110	−64.3		22	112	−65.2		23	111	−68.9		24	109	−60.3		26	107	−54.4		22	112	−67.5		16	111	−66.3	
17,000	14	93	−63.2		21	95	−64.2		21	94	−65.9		19	93	−59.3		20	91	−53.8		21	95	−66.0		14	94	−65.4	
18,000	8	79	−59.7		19	80	−61.3		18	79	−61.6		12	79	−57.4		14	78	−53.7		18	80	−63.7		10	80	−63.0	
19,000					14	69	−59.0		14	68	−58.2										12	68	−61.1		5	67	−60.0	
20,000					8	58	−56.6		8	58	−55.4																	

TABLE 1.—*Mean free-air barometric pressure in millibars, temperature in degrees Centigrade, and relative humidities in percent, obtained by airplanes and radiosondes during September 1941*—Continued

Stations with elevations in meters above sea level

Altitude (meters) m. s. l.	Lake Charles, La. (5 m.)				Lakehurst, N. J.[1] (39 m.)				Medford Oreg. (401 m.)				Miami, Fla. (4 m.)			
	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity
Surface	29	1014	23.9	92	29	1015	14.6	84	31	968	15.0	66	31	1015	24.8	91
500	29	959	24.0	79	29	961	16.4	75	31	956	15.7	63	31	960	23.4	93
1,000	28	906	21.4	78	29	907	14.7	66	31	902	13.2	63	31	906	20.4	86
1,500	28	854	18.5	77	29	855	13.4	54	31	850	10.0	68	31	855	17.8	78
2,000	28	806	15.6	69	29	805	11.3	49	31	799	7.0	70	31	806	15.0	73
2,500	28	760	13.3	60	29	758	9.5	43	31	752	4.6	61	31	760	12.3	68
3,000	28	716	10.6	57	29	714	7.3	35	31	707	2.3	53	31	716	9.7	64
4,000	27	634	5.2	50	29	631	2.3	25	31	624	−2.9	46	31	634	4.5	61
5,000	27	561	−0.2	46	29	557	−2.7	23	31	550	−8.8	42	31	561	−1.0	57
6,000	26	494	−6.0	45	29	490	−8.4	22	31	482	−15.2	40	31	494	−6.8	56
7,000	24	434	−12.5	41	28	430	−15.0	26	31	422	−21.9	40	31	434	−13.2	54
8,000	23	380	−19.7	38	27	376	−21.8	31	30	368	−29.5	40	31	380	−19.8	53
9,000	22	331	−27.1	36	27	327	−29.1	37	30	318	−37.2	39	31	331	−26.8	52
10,000	21	288	−35.0	34	23	284	−36.6		29	275	−44.5		30	288	−34.5	51
11,000	20	249	−43.1		23	246	−44.5		29	237	−50.4		30	249	−42.5	
12,000	20	214	−51.1		20	211	−52.0		29	203	−54.8		30	214	−50.5	
13,000	18	183	−59.1		19	180	−58.8		29	173	−57.0		29	183	−58.3	
14,000	18	156	−66.8		19	153	−63.5		29	148	−58.9		27	156	−65.3	
15,000	15	132	−72.3		19	130	−67.4		28	126	−60.0		27	132	−71.1	
16,000	14	112	−74.9		19	110	−69.2		27	107	−60.1		27	112	−73.7	
17,000	10	94	−74.0		18	93	−69.2		24	91	−59.7		25	94	−72.1	
18,000	6	79	−68.2		15	79	−67.6		18	78	−58.6		22	79	−68.3	
19,000					14	67	−65.3		8	66	−56.9		15	67	−64.2	
20,000					10	57	−62.9						8	57	−60.9	
21,000					5	48	−60.8									

Altitude (meters) m. s. l.	Nashville, Tenn. (180 m.)				Norfolk, Va.[1 2] (10 m.)				Oakland, Calif. (2 m.)			
	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity
Surface	31	997	22.2	71	25	1020	21.5	80	31	1012	16.6	75
500	31	961	23.9	62	25	964	21.4	68	31	955	16.9	60
1,000	31	908	21.2	64	25	909	18.5	68	31	900	16.7	44
1,500	31	857	17.9	68	25	858	16.2	66	31	850	14.7	37
2,000	31	808	14.7	66	25	808	13.8	62	31	800	11.9	32
2,500	31	761	12.0	58	25	761	11.9	50	31	753	9.1	27
3,000	31	717	9.6	50	25	717	9.3	44	31	709	6.5	24
4,000	31	635	4.8	39	25	635	3.1	39	31	627	1.0	21
5,000	31	561	−0.3	32	23	560	−3.0	29	31	553	−5.0	20
6,000	30	495	−6.5	31					31	486	−11.4	18
7,000	30	435	−13.0	30					30	426	−18.4	17
8,000	29	380	−20.0	26					30	372	−25.8	17
9,000	29	332	−26.9	23					30	323	−33.6	17
10,000	29	288	−34.0	22					29	280	−40.6	
11,000	29	249	−40.9						29	241	−47.0	
12,000	29	215	−47.8						28	207	−52.0	
13,000	28	184	−54.5						28	177	−55.8	
14,000	28	158	−60.6						27	152	−58.7	
15,000	26	134	−65.5						25	129	−60.8	
16,000	25	114	−68.6						22	110	−62.1	
17,000	22	96	−68.8						21	93	−62.0	
18,000	17	81	−66.6						20	79	−60.8	
19,000	12	69	−63.6						14	68	−59.0	
20,000	6	58	−60.2						7	57	−57.0	
21,000												

Stations with elevations in meters above sea level

Altitude (meters) m. s. l.	Oklahoma City, Okla. (391 m.)				Omaha, Nebr. (301 m.)				Pensacola, Fla.[1] (24 m.)				Phoenix, Ariz. (339 m.)			
	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity
Surface	31	969	21.3	78	31	979	18.0	81	19	1,015	26.6	85	31	968	24.4	48
500	31	957	22.1	73	31	956	19.0	69	19	961	23.9	76	31	951	28.1	33
1,000	31	904	21.4	66	31	902	17.8	65	19	908	21.1	67	31	898	26.3	27
1,500	31	854	19.0	67	31	851	16.1	61	19	856	18.1	67	31	849	22.8	27
2,000	31	805	15.9	67	31	802	13.7	60	19	807	15.2	67	31	801	18.7	32
2,500	31	759	12.9	62	31	756	10.9	59	19	761	12.3	65	31	755	14.5	40
3,000	31	715	10.3	58	31	712	7.9	58	19	717	9.6	61	31	711	10.7	42
4,000	30	633	5.0	49	30	630	2.6	53	19	635	4.2	61	31	630	5.1	35
5,000	29	560	−.5	44	30	556	−3.1	47	19	561	−1.4	58	31	557	−0.4	27
6,000	28	493	−6.5	42	29	489	−9.3	43	19	494	−7.0	50	29	491	−6.5	23
7,000	28	433	−13.0	39	27	429	−16.0	40	18	434	−13.4	47	27	431	−13.6	20
8,000	27	379	−19.8	37	26	375	−22.6	38	14	380	−20.2	47	27	378	−20.7	19
9,000	27	330	−26.7	37	23	326	−29.1	37	13	332	−27.6	45	27	329	−27.9	19
10,000	27	288	−33.7	37	23	284	−36.1	35	8	288	−34.9		27	286	−35.0	19
11,000	27	248	−41.1		23	245	−43.4		5	249	−42.2		26	247	−41.8	
12,000	27	214	−48.4		20	211	−50.4						26	213	−48.4	
13,000	27	184	−54.8		18	181	−56.4						25	183	−54.4	
14,000	27	157	−60.7		17	154	−61.0						25	156	−59.5	
15,000	26	133	−65.7		17	131	−63.9						20	133	−63.9	
16,000	24	113	−68.2		16	111	−64.9						17	113	−67.3	
17,000	23	95	−68.6		15	94	−64.9						17	95	−67.1	
18,000	21	80	−66.4		14	80	−62.6						15	81	−64.8	
19,000	14	68	−62.9		12	68	−59.8						7	69	−61.0	
20,000	5	58	−59.8		8	58	−57.6									

Altitude (meters) m. s. l.	Portland, Maine (19 m.)				St. Louis, Mo. (171 m.)				St. Paul, Minn. (225 m.)			
	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity
Surface	31	1,014	12.0	82	31	996	20.4	74	31	987	15.9	77
500	31	958	14.5	68	31	959	21.3	65	31	956	15.4	71
1,000	31	903	12.8	66	31	906	19.0	64	31	901	13.8	68
1,500	31	851	10.8	66	31	854	16.5	63	31	849	12.2	64
2,000	31	801	8.8	59	31	805	14.2	59	31	799	10.2	61
2,500	31	754	7.0	54	31	759	11.8	53	31	752	7.8	57
3,000	31	709	4.5	52	31	714	8.8	50	31	708	5.4	51
4,000	31	627	.7	48	30	633	3.8	45	30	626	.2	48
5,000	31	553	−6.1	47	30	550	−1.8	40	29	552	−5.4	44
6,000	31	486	−12.2	44	30	492	−8.0	33	29	485	−11.5	40
7,000	30	425	−19.3	43	30	432	−14.4	28	28	425	−18.1	36
8,000	30	371	−26.5	42	28	378	−21.4	27	28	371	−24.7	34
9,000	30	322	−33.9	40	28	329	−28.5	26	28	323	−31.7	36
10,000	30	279	−41.4		28	286	−35.7	25	28	280	−38.4	36
11,000	30	240	−48.2		28	247	−42.8		27	242	−44.7	
12,000	29	206	−54.3		27	213	−49.8		27	208	−50.1	
13,000	28	176	−58.8		27	182	−56.2		23	178	−55.3	
14,000	25	150	−62.1		27	155	−61.7		21	152	−59.7	
15,000	24	127	−64.0		27	132	−65.7		21	129	−61.6	
16,000	22	108	−63.9		27	112	−67.1		21	110	−62.3	
17,000	18	92	−62.2		25	94	−65.9		18	93	−61.1	
18,000	12	78	−59.6		23	80	−63.2		15	79	−59.3	
19,000	6	66	−56.4		18	68	−60.6		8	67	−57.5	
20,000					12	58	−57.8		6	57	−55.3	

See footnotes at end of table.

TABLE 1.—*Mean free-air barometric pressure in millibars, temperature in degrees Centigrade, and relative humidities in percent, obtained by airplanes and radiosondes during September 1941*—Continued

Stations with elevations in meters above sea level

Altitude (meters) m. s. l.	San Diego, Calif.[1] (19 m.)				San Antonio, Tex. (174 m.)				Sault Ste. Marie, Mich. (221 m.)				Seattle, Wash.[1] (27 m.)			
	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity
Surface	30	1,008	18.6	83	31	993	25.1	82	31	989	12.3	89	29	1,013	13.7	85
500	30	953	16.7	79	31	958	24.0	83	31	957	12.8	84	29	957	11.3	85
1,000	30	899	18.0	54	31	905	22.0	77	31	902	11.1	79	29	902	8.6	84
1,500	30	848	17.3	37	31	854	19.5	76	31	849	9.0	74	29	849	5.8	86
2,000	30	800	15.5	31	31	806	16.8	74	31	799	7.3	66	29	798	3.0	85
2,500	30	753	13.1	26	31	760	14.2	68	31	752	5.3	59	29	750	0.1	77
3,000	30	710	10.7	21	31	716	11.6	64	31	707	3.3	58	29	704	−2.4	70
4,000	30	629	5.2	15	31	635	6.9	53	30	624	−2.2	54	29	620	−8.0	60
5,000	30	555	−0.9	15	30	561	1.2	52	30	550	−7.6	56	29	544	−14.1	55
6,000	30	489	−7.5	19	30	495	−4.2	47	30	483	−13.4	52	29	476	−20.9	58
7,000	28	430	−14.9	19	30	436	−10.4	42	28	423	−20.0	45	29	415	−27.8	57
8,000	22	376	−22.5		29	382	−17.2	39	28	368	−27.2	44	29	361	−34.5	60
9,000	22	327	−30.1		29	333	−24.0	39	28	320	−34.6	44	28	312	−41.1	
10,000	21	284	−37.2		27	290	−30.9	39	27	277	−41.2		28	269	−47.5	
11,000	19	245	−44.1		27	252	−38.1	37	27	238	−47.2		28	231	−52.1	
12,000	17	211	−50.7		27	217	−45.6		25	204	−52.7		26	198	−53.9	
13,000	13	181	−55.9		26	187	−53.2		23	174	−57.6		25	170	−55.3	
14,000	11	154	−60.8		24	159	−60.5		21	148	−60.5		23	146	−55.7	
15,000	9	132	−64.1		21	135	−66.8		20	126	−61.8		21	124	−55.7	
16,000	7	111	−66.4		18	115	−71.5		16	107	−61.5		19	106	−55.3	
17,000	6	95	−66.4		17	96	−72.1		10	91	−60.0		13	90	−55.0	
18,000	6	81	−65.1		17	81	−69.9		7	77	−58.4		6	77	−55.0	
19,000			−66.7		15	69	−66.2						6	65	−55.0	
20,000					13	58	−62.2									
21,000					9	49	−58.2									

Altitude (meters) m. s. l.	Spokane, Wash. (598 m.)				Washington, D. C. (5 m.)				Anchorage, Alaska (42 m.)			
	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity
Surface	31	944	11.8	75	31	1,017	20.5	74	31	1,006	11.3	70
500					31	963	20.3	62	31	952	9.2	67
1,000	31	899	11.3	67	31	909	17.8	60	31	896	6.0	71
1,500	31	847	7.9	67	31	857	15.5	58	31	843	2.6	74
2,000	31	797	4.1	70	31	808	13.4	54	31	792	−.7	75
2,500	31	749	0.6	73	31	761	11.3	49	31	744	−3.7	72
3,000	30	703	−2.6	73	31	717	8.9	43	31	698	−6.5	69
4,000	29	620	−8.2	68	31	635	4.0	36	30	613	−12.3	63
5,000	29	544	−14.6	65	31	560	−1.1	30	28	537	−18.5	57
6,000	29	476	−21.4	61	30	494	−6.9	25	27	469	−25.0	56
7,000	29	415	−28.3	59	30	434	−13.2	25	27	408	−32.0	55
8,000	28	360	−35.5	58	30	380	−20.2	25	26	353	−39.0	56
9,000	27	311	−42.4		30	331	−27.6	24	25	304	−45.2	
10,000	27	268	−48.6		30	288	−35.0	22	23	262	−49.0	
11,000	26	230	−53.4		30	249	−42.4		23	225	−49.4	
12,000	26	196	−53.8		30	214	−49.6		23	193	−48.8	
13,000	25	168	−54.1		30	184	−56.2		19	166	−48.8	
14,000	24	143	−54.6		30	156	−61.5		19	143	−49.7	
15,000	21	123	−55.2		30	133	−65.5		18	123	−50.2	
16,000	15	105	−55.0		27	113	−67.8		16	106	−50.4	
17,000	9	89	−54.9		25	96	−67.1		16	91	−50.5	
18,000	6	76	−53.9		25	81	−64.9		10	78	−50.9	
19,000					20	69	−62.8		8	67	−50.9	
20,000					13	58	−60.2					
21,000					6	50	−57.5					

Stations with elevations in meters above sea level

Altitude (meters) m. s. l.	Juneau, Alaska (49 m.)				Atlantic Station No. 1 (3 m.)[3]				Atlantic Station No. 2 (3 m.)[4]			
	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity
Surface	31	1,006	11.0	77	27	1,017	21.8	72	27	1,016	20.9	78
500	31	952	9.7	73	27	961	17.7	79	27	959	16.8	84
1,000	31	897	6.5	73	27	906	14.4	83	27	904	13.4	86
1,500	31	843	3.2	75	27	854	12.4	72	27	852	10.8	83
2,000	31	792	0.1	77	27	804	11.3	56	27	802	9.0	77
2,500	31	744	−3.0	77	27	758	9.5	45	27	755	7.8	67
3,000	31	698	−5.9	78	27	713	7.3	40	27	710	5.6	62
4,000	31	614	−12.0	74	26	631	2.6	33	26	628	0.2	59
5,000	31	538	−18.6	71	25	557	−2.7	29	26	554	−5.2	52
6,000	31	470	−25.3	69	25	490	−8.5	29	26	486	−11.1	47
7,000	29	408	−32.1	67	25	431	−14.9	28	23	427	−17.2	45
8,000	28	354	−39.1	63	25	377	−21.9	28	22	373	−23.9	43
9,000	23	305	−45.5		24	328	−28.7	27	21	324	−31.3	40
10,000	22	262	−49.8		24	285	−36.0	24	21	281	−38.5	38
11,000	19	225	−50.2		24	246	−43.1		21	242	−45.6	
12,000	18	193	−48.4		24	212	−50.4		19	208	−52.2	
13,000	18	166	−48.3		24	182	−56.5		19	178	−56.6	
14,000	17	142	−48.8		22	155	−60.7		19	151	−59.9	
15,000	17	122	−49.3		22	132	−64.2		18	129	−61.9	
16,000	16	105	−49.9		21	112	−66.1		16	110	−62.2	
17,000	12	90	−49.9		21	94	−65.6		13	93	−61.3	
18,000	5	77	−50.1		18	80	−63.1		9	79	−59.3	
19,000					11	68	−59.8					
20,000					5	58	−57.0					

Altitude (meters) m. s. l.	Barrow, Alaska (6 m.)				Bethel, Alaska (7 m.)				Coco Solo, C. Z.[1 2] (15 m.)				Fairbanks, Alaska (156 m.)			
	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity
Surface					29	1,009	10.2	76	18	1,011	26.2	93	31	994	9.8	56
500					29	952	8.8	78	18	956	24.6	81	31	954	7.1	56
1,000					29	896	6.2	79	18	903	22.0	75	31	898	3.3	61
1,500					29	842	3.5	80	18	852	19.3	70	31	843	−.3	65
2,000					29	792	1.0	78	18	803	16.2	67	31	792	−2.9	66
2,500					29	744	−1.5	75	18	757	13.6	53	31	743	−5.5	65
3,000					28	698	−4.4	74	17	713	10.7	48	31	697	−8.4	62
4,000					28	614	−10.2	68	9	632	3.1	53	31	612	−14.7	58
5,000					27	539	−16.8	68					31	536	−21.2	56
6,000					27	471	−23.0	64					31	467	−28.3	56
7,000					27	410	−29.4	61					30	405	−35.3	53
8,000					25	356	−36.4	59					29	350	−41.9	
9,000					23	307	−42.7						27	302	−47.5	
10,000					23	264	−47.4						26	259	−51.3	
11,000					23	228	−47.2						25	222	−51.7	
12,000					22	196	−46.5						25	190	−50.1	
13,000					21	168	−46.7						25	164	−49.6	
14,000					21	145	−46.9						24	140	−49.9	
15,000					19	124	−47.5						22	120	−50.0	
16,000					15	107	−47.9						16	103	−50.1	
17,000					12	92	−48.1						10	88	−50.2	
18,000					6	79	−48.2									
19,000																
20,000																

See footnotes at end of table.

TABLE 1.—*Mean free-air barometric pressure in millibars, temperature in degrees Centigrade, and relative humidities in percent, obtained by airplanes and radiosondes during September 1941*—Continued

Stations with elevations in meters above sea level

Altitude (meters) M. S. L.	Ketchikan, Alaska (26 m.)				Nome, Alaska (14 m.)				Pearl Harbor, T. H. (7 m.) [1]			
	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity
Surface	30	1,008	11.9	82	30	1,010	9.5	70	21	1,013	24.7	78
500	30	953	10.7	81	29	952	6.2	72	21	957	21.7	84
1,000	30	897	7.5	82	29	896	3.2	72	21	904	18.6	86
1,500	30	844	4.0	83	29	842	.9	72	21	853	15.8	81
2,000	30	793	0.6	85	29	791	−1.1	67	21	804	13.4	75
2,500	30	745	−2.2	80	29	742	−3.9	66	21	758	11.5	62
3,000	30	699	−5.1	75	29	697	−6.6	64	21	713	9.1	54
4,000	30	615	−11.3	67	28	612	−12.0	56	21	631	3.8	47
5,000	29	539	−18.2	64	28	537	−18.4	55	21	557	−2.0	43
6,000	28	470	−24.2	61	28	469	−25.2	51	21	490	−8.0	41
7,000	28	409	−32.3	61	29	407	−32.1	50	21	430	−14.8	39
8,000	28	354	−39.1	62	27	353	−39.2	50	20	377	−21.9	36
9,000	28	305	−45.2		25	305	−45.3		20	328	−29.7	33
10,000	24	262	−48.8		25	262	−50.1		20	285	−37.2	33
11,000	21	226	−50.3		25	225	−50.5		19	246	−44.5	
12,000	19	193	−49.3		23	193	−49.5		18	211	−52.0	
13,000	19	166	−49.4		22	166	−49.0		16	180	−58.8	
14,000	18	142	−50.3		21	142	−49.2		14	154	−65.1	
15,000	17	122	−51.3		20	122	−49.3		10	130	−69.8	
16,000	10	104	−51.5		20	105	−49.3		8	110	−72.8	
17,000					18	90	−49.3		6	93	−73.6	
18,000					14	78	−49.5		5	78	−75.7	
19,000					11	67	−49.9					
20,000					5	57	−50.2					
21,000												
22,000												
23,000												
24,000												
25,000												

Altitude (meters) M. S. L.	San Juan, P. R. (15 m.)				St. Thomas, V. I. [1, 2] (8 m.)				Swan Island, West Indies (10 m.)			
	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity
Surface	31	1,012	25.5	90					31	1,010	27.8	82
500	31	959	23.6	87					31	956	24.6	88
1,000	31	906	20.9	85					31	903	21.9	82
1,500	31	855	18.2	84					31	852	19.2	78
2,000	31	806	15.4	75					31	804	16.7	72
2,500	31	759	13.6	69					31	758	14.1	69
3,000	31	716	11.0	65					31	714	11.3	65
4,000	30	634	5.0	60					30	633	5.7	60
5,000	30	561	−0.8	58					30	560	.2	57
6,000	29	494	−6.6	58					29	494	−5.9	58
7,000	29	435	−12.7	56					29	434	−11.6	56
8,000	28	380	−19.5	53					28	381	−17.8	52
9,000	28	331	−26.8	53					28	332	−24.5	48
10,000	28	288	−34.5	52					28	289	−31.7	47
11,000	27	250	−42.3						28	250	−39.1	
12,000	27	215	−50.4						28	216	−46.7	
13,000	26	184	−58.4						28	185	−54.4	
14,000	25	156	−65.6						27	158	−62.3	
15,000	25	132	−71.5						27	134	−69.6	
16,000	24	112	−74.6						26	113	−75.3	
17,000	23	94	−74.0						25	95	−76.8	
18,000	21	79	−72.6						21	80	−74.8	
19,000	17	67	−69.7						14	67	−72.2	
20,000	11	57	−65.1						8	57	−68.5	
21,000	8	48	−61.1									
22,000	7	41	−58.4									
23,000	7	34	−56.2									
24,000	7	29	−53.9									
25,000	5	25	−52.7									

[1] U. S. Navy.
[2] Airplane observations.
[3] Observations made on Coast Guard vessels in or near the 5° square.
Lat. 35°00′ N. to 40°00′ N.
Long. 55°00W. to 60°00′ W.
[4] Observations made on Coast Guard vessels in or near the 5° square.
Lat. 35° 0″ N. to 40°00′ N.
Long. 45°00 W to 50°00′ W.

NOTE.—All observations taken at 12:30 a. m. from September 1 thru 14, and at 11 p.m. thereafter 75th meridian time, except at Lakehurst N. J. where they are taken near 5 a.m. E. S. T., at Norfolk Va., where they are taken at about 6 a. m. and at Pearl Harbor, T. H. at 7 a. m.

None of the means included in this table are based on less than 15 surface or 5 standard level observations.

Number of observations refers to pressure only as temperature and humidity data are missing for some observations at certain levels; also, the humidity data are not used in daily observations when the temperature is below −40.0° C.

TABLE 2.—*Free-air resultant winds based on pilot balloon observations made near 5 p. m. (75th meridian time) during September 1941. Directions given in degrees from North (N=360°, E=90°, S=180°, W=270°)—Velocities in meters per second*

Altitude (meters) m. s. l.	Abilene, Tex. (537 m.)			Albuquerque, N. Mex. (1,630 m.)			Atlanta, Ga. (299 m.)			Billings, Mont. (1,095 m.)			Bismarck, N. Dak. (512 m.)			Boise, Idaho (866 m.)			Brownsville, Tex. (7 m.)		
	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity
Surface	30	162	3.8	30	215	2.6	30	104	1.3	25	252	1.0	27	234	2.4	29	314	4.0	30	111	3.7
500							30	94	1.8										30	119	5.2
1,000	30	154	4.8				30	111	1.8				27	256	2.6	29	314	3.9	27	125	3.9
1,500	30	162	5.5				30	119	1.9	25	247	2.1	24	241	4.3	29	303	4.0	24	125	2.6
2,000	28	171	5.8	30	212	3.8	29	113	2.1	24	251	2.9	22	242	5.7	29	298	3.7	23	123	2.5
2,500	26	178	5.1	30	222	3.7	28	137	0.9	21	247	5.4	21	249	7.6	29	268	5.0	20	124	3.1
3,000	23	189	4.3	29	231	4.6	27	128	1.0	20	254	6.4	20	254	10.8	29	265	5.1	17	124	4.4
4,000	22	229	4.6	27	260	7.7	24	122	1.3	16	242	9.6	20	252	13.3	29	272	6.3	16	106	2.7
5,000	20	237	4.7	25	258	10.0	22	195	0.2	14	248	13.1	20	255	16.2	23	269	8.6	14	103	3.0
6,000	19	249	5.0	21	253	12.3	21	186	0.6	12	251	18.9	16	251	20.1	19	289	8.4	12	116	3.1
8,000	17	250	9.3	20	251	15.4	18	329	1.4				13	247	27.5	12	327	10.9			
10,000	15	258	14.8	17	254	18.6	16	328	4.1												
12,000	14	252	16.0	11	244	19.8	14	313	7.6												
14,000	11	262	17.8				10	341	11.7												

Altitude (meters) m. s. l.	Buffalo, N. Y. (220 m.)			Burlington, Vt. (132 m.)			Charleston, S. C. (17 m.)			Chicago, Ill. 192 m.)			Cincinnati, Ohio (152 m.)			Denver, Colo. (1,627 m.)		
	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity
Surface	30	246	4.2	30	206	1.4	30	105	1.6	29	222	1.8	30	202	0.9	29	135	1.9
500	30	245	6.0	30	225	3.7	30	102	3.0	29	217	2.8	30	220	1.8			
1,000	29	245	8.3	30	260	6.3	29	86	1.8	29	231	5.1	29	217	2.9			
1,500	28	255	9.0	30	269	8.4	29	47	1.3	27	239	7.0	29	235	3.5			
2,000	26	260	9.7	26	276	8.8	27	20	0.8	24	247	8.5	28	248	5.0	29	133	1.6
2,500	22	276	9.6	21	285	9.8	25	17	0.8	22	256	8.6	27	253	6.4	29	170	1.6
3,000	19	281	10.5	16	299	11.8	23	16	1.0	21	253	9.8	23	266	6.5	28	217	4.0
4,000	17	287	12.0				19	289	0.8	19	274	10.5	21	268	6.8	24	248	7.7
5,000	15	287	11.0				16	326	1.7	17	272	12.9	17	280	5.8	22	256	11.6
6,000	14	290	12.7				13	10	2.0	17	269	15.2	15	286	5.2	20	257	15.4
8,000	12	282	13.6							12	275	16.3	10	321	5.8	14	271	17.8
10,000										10	281	19.2				13	268	19.4
12,000																		
14,000																		

TABLE 2.—*Free-air resultant winds based on pilot balloon observations made near 5 p. m. (75th meridian time) during September 1941. Directions given in degrees from North (N=360°, E=90°, S=180°, W=270°)—Velocities in meters per second*—Continued

Altitude (meters) m. s. l.	El Paso, Tex. (1,196 m.)			Ely, Nev. (1,910 m.)			Grand Junction, Colo. (1,413 m.)			Greensboro, N. C. (271 m.)			Havre, Mont. (767 m.)			Jacksonville, Fla. (14 m.)			Las Vegas, Nev. (570 m.)		
	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity
Surface	30	178	2.7	30	241	2.2	29	277	0.6	29	75	1.0	25	264	2.5	29	70	3.9	30	184	1.2
500										29	80	1.0				29	77	5.3			
1,000										29	179	0.7	25	263	4.5	26	91	3.9	30	196	2.0
1,500	30	178	2.7							29	215	1.2	25	267	6.1	26	115	2.8	30	204	2.3
2,000	30	190	2.2	30	240	2.8	29	254	1.8	29	252	1.5	25	262	7.2	24	111	2.1	30	209	3.1
2,500	30	205	2.8	30	247	3.3	29	226	3.8	28	292	2.2	24	264	8.7	23	107	2.0	30	231	3.6
3,000	28	227	3.6	29	244	3.6	28	226	5.8	26	316	2.9	23	263	8.6	20	118	1.7	30	236	4.7
4,000	22	245	5.9	28	242	5.9	25	231	7.8	24	313	3.8	17	256	8.2	14	124	1.6	29	241	7.9
5,000	16	251	7.4	24	252	11.4	21	244	10.9	23	300	3.2	14	266	10.4	12	111	1.5	27	250	9.4
6,000	13	250	8.8	22	252	14.0	20	249	15.0	23	313	4.5	10	267	13.5	12	33	1.2	27	253	13.4
8,000				20	259	18.9	11	284	14.0	22	308	4.6				12	31	1.4	24	256	15.5
10,000				18	268	19.7				21	324	4.3				10	184	1.1	19	278	14.4
12,000				17	272	21.5				15	302	2.4				10	261	2.8	17	268	19.1
14,000				15	264	21.2										10	2	1.1	12	260	18.0
16,000				12	257	15.3													10	261	11.2

Altitude (meters) m. s. l.	Little Rock, Ark. (79 m.)			Medford, Oreg. (410 m.)			Miami, Fla. (10 m.)			Minneapolis, Minn. (265 m.)			Mobile, Ala. (8 m.)			Nashville, Tenn. (194 m.)		
	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity
Surface	28	121	1.3	30	315	2.5	30	86	3.7	29	219	3.3	30	134	2.0	30	188	1.3
500	28	151	2.6	30	319	2.5	30	87	4.6	29	217	4.8	30	123	4.2	30	182	1.6
1,000	26	165	3.1	30	315	1.8	30	91	4.3	29	215	6.4	29	119	4.7	30	203	2.0
1,500	25	177	3.3	30	294	1.2	30	103	4.3	28	229	8.2	27	118	4.7	30	210	1.7
2,000	24	179	3.3	28	299	0.7	29	100	3.8	20	243	9.7	22	104	4.3	27	218	2.9
2,500	22	196	4.1	26	320	1.9	29	98	3.8	16	242	8.5	18	111	3.7	25	229	3.5
3,000	18	227	4.0	27	323	3.4	28	104	3.8	15	249	10.2	15	123	3.6	23	240	3.5
4,000	17	225	5.3	23	326	7.0	26	112	3.6	11	268	14.4	12	145	2.9	18	265	6.2
5,000	13	244	7.6	23	314	9.4	22	116	3.7	11	276	18.4	10	134	3.3	15	264	5.7
6,000	10	247	7.0	23	307	11.4	20	120	3.2							10	292	3.5
8,000				20	306	16.4	13	78	2.8									
10,000				15	298	17.7												
12,000																		
14,000																		
16,000																		

Altitude (meters) m. s. l.	New York, N. Y. (15 m.)			Oakland, Calif. (8 m.)			Oklahoma City, Okla. (402 m.)			Omaha, Nebr. (306 m.)			Phoenix, Ariz. (338 m.)			Rapid City, S. Dak. (982 m.)			St. Louis, Mo. (181 m.)		
	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity
Surface	30	216	1.8	30	281	5.3	28	164	5.2	29	173	2.7	30	273	0.9	30	356	1.2	30	166	2.2
500	30	242	3.5	30	295	2.7	28	166	6.1	29	182	4.4	30	266	1.0				30	183	3.5
1,000	30	265	5.2	29	328	1.8	28	172	7.2	28	198	6.8	30	235	1.4	30	352	1.1	29	202	4.3
1,500	29	277	6.7	29	338	1.8	28	191	6.8	28	210	8.1	30	201	2.8	30	298	1.3	29	215	5.1
2,000	25	283	6.7	29	313	1.4	27	204	6.6	25	227	9.7	30	198	3.6	26	244	3.4	27	223	5.8
2,500	21	290	7.2	29	340	1.9	25	210	7.3	21	245	9.9	30	205	5.4	24	246	6.0	25	231	5.8
3,000	17	312	7.4	29	334	2.8	22	217	7.6	18	242	10.8	29	220	5.9	23	245	8.0	22	242	6.8
4,000	13	309	7.9	29	312	5.3	16	237	7.8	17	257	13.6	28	225	7.5	22	252	13.3	22	247	8.3
5,000	10	323	8.1	29	301	7.9	14	245	8.5	16	262	14.7	27	240	9.0	18	249	15.4	20	255	10.0
6,000				28	293	9.9	11	252	10.4	14	260	17.9	23	255	9.3	18	248	17.4	18	257	10.9
8,000				21	291	10.9				11	258	21.6	21	250	12.0	13	251	21.4	17	268	13.3
10,000				18	280	13.0							17	254	17.4				13	271	9.3
12,000				15	280	15.3							11	248	17.2						
14,000													11	252	20.3						

Altitude (meters) m. s. l.	San Antonio, Tex. (180 m.)			San Diego, Calif. (15 m.)			Sault St. Marie, Mich. (230 m.)			Seattle, Wash. (12m.)			Spokane, Wash. (603 m.)			Washington, D. C. (24 m.)		
	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity
Surface	30	97	3.2	30	274	4.5	26	238	1.9	28	199	2.3	28	237	2.9	30	204	1.2
500	30	101	4.7	30	293	2.6	26	229	4.0	28	215	3.5				30	220	1.8
1,000	29	105	4.6	29	211	0.8	24	226	6.1	26	229	4.8	28	237	4.2	28	251	2.7
1,500	29	112	4.3	29	238	0.2	21	241	6.3	22	240	4.1	27	237	4.3	26	281	3.3
2,000	25	133	4.0	27	258	1.7	14	256	7.8	18	246	4.1	23	249	4.9	24	298	4.7
2,500	24	142	3.7	27	257	3.2	14	264	9.0	17	267	5.3	16	258	6.4	24	289	5.6
3,000	22	147	3.2	26	260	6.1	12	264	9.0	13	296	6.1	13	277	5.8	23	290	5.8
4,000	16	171	1.8	23	268	8.4	10	283	10.1	10	308	9.5				21	292	6.5
5,000	13	201	2.3	17	274	8.3										19	308	5.7
6,000	13	205	2.2	10	275	7.5										18	305	6.5
8,000	10	264	2.3													13	322	6.8
10,000																		
12,000																		
14,000																		

TABLE 3.—*Maximum free-air wind velocities, (m. p. s.), for different sections of the United States, based on pilot balloon observations during September 1941*

Section	Surface to 2,500 meters (m. s. l.)					Between 2,500 and 5,000 meters (m. s. l.)					Above 5,000 meters (m. s. l.)				
	Maximum velocity	Direction	Altitude (m.) m. s. l.	Date	Station	Maximum velocity	Direction	Altitude (m.) m. s. l.	Date	Station	Maximum velocity	Direction	Altitude (m.) m. s. l.	Date	Station
Northeast [1]	40.9	WSW	1,020	25	Buffalo, N. Y.	53.6	WNW	4,780	7	Boston, Mass.	64.0	WNW	9,460	2	Boston, Mass.
East-Central [2]	31.4	SSW	1,470	25	Knoxville, Tenn.	32.4	W	3,660	28	Cincinnati, Ohio	62.0	WNW	19,240	12	Louisville, Ky.
Southeast [3]	23.2	E ESE ENE	1,000 620 820	29 22 20	Key West, Fla.; Mobile, Ala.; Tallahassee, Fla.	20.4	SE	2,610	9	Tampa, Fla.	45.0	WSW	17,670	27	Tampa, Fla.
North-Central [4]	37.6	W	1,741	6	Green Bay, Wis.	47.4	W	5,000	30	Fargo, N. Dak.	68.8	WNW	10,420	10	Fargo, N. Dak.
Central [5]	44.5	WSW	1,100	27	Des Moines, Iowa	42.0	WNW	5,000	5	Des Moines, Iowa	62.4	SW	11,880	9	Wichita, Kans.
South-Central [6]	37.2	S	1,630	24	Jackson, Miss.	29.4	WNW	2,870	24	Little Rock, Ark.	56.0	SW	13,310	9	Abilene, Tex.
Northwest [7]	42.0	W	1,540	15	Great Falls, Mont.	33.0	NNW	4,640	7	Medford, Oreg.	57.0	N	8,900	7	Ellensburg, Wash.
West-Central [8]	48.6	SSW	2,080	11	Modena, Utah	55.0	SSW	4,340	18	Ely, Nev.	70.4	WSW	10,910	11	Reno, Nev.
Southwest [9]	35.2	S	1,860	20	Albuquerque, N.M.	54.4	SSW	3,750	28	Tucson, Ariz.	67.0	SW	13,380	20	Winslow, Ariz.

[1] Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania and Northern Ohio.
[2] Delaware, Maryland, Virginia, West Virginia, Southern Ohio, Kentucky, Eastern Tennessee and North Carolina.
[3] South Carolina, Georgia, Florida and Alabama.
[4] Michigan, Wisconsin, Minnesota, North Dakota and South Dakota.
[5] Indiana, Illinois, Iowa, Nebraska, Kansas and Missouri.
[6] Mississippi, Arkansas, Louisiana, Oklahoma, Texas (except El Paso), and Western Tennessee.
[7] Montana, Idaho, Washington and Oregon.
[8] Wyoming, Colorado, Utah, Northern Nevada and Northern California.
[9] Southern California, Southern Nevada, Arizona, New Mexico, and extreme West Texas.

WEATHER ON THE NORTH ATLANTIC OCEAN

By H. C. HUNTER

Atmospheric pressure.—The pressure, as far as available information shows, tended to fall below normal. Near the Azores it averaged considerably less than normal, and it was somewhat deficient over waters adjacent to Newfoundland and the Maritime Provinces. On the other hand, pressure averaged slightly above normal near the coasts of the Middle and South Atlantic States.

The extremes of pressure noted in vessel reports at hand were 1032.0 and 985.8 millibars (30.47 and 29.11 inches). The high mark was noted during the forenoon of the 14th about 200 miles to eastward of the Chesapeake Capes, while the low mark was recorded over the western Gulf of Mexico, about 27° N., 94° W., where the second of the Gulf disturbances was prevailing early in the evening of the 22d. Somewhat later, when this storm center crossed the Texas coastline, lower pressure was noted at certain land stations.

Over the main North Atlantic the lowest mark was 995.3 millibars (29.39 inches), during early forenoon of the 20th, at about 30° N., 70° W., under the influence of the storm of tropical origin which affected waters east of the Southeastern States.

TABLE 1.—*Averages, departures, and extremes of atmospheric pressure (sea level) at selected stations for the North Atlantic Ocean and its shores, September 1941*

Station	Average pressure	Departure from normal	Highest	Date	Lowest	Date
	Millibars	*Millibars*	*Millibars*		*Millibars*	
Lisbon, Portugal [1]			1,021	13	1,013	7
Horta, Azores	1,018.3	−3.4	1.026	27	1,009	18
Belle Isle, Newfoundland	1,009.6	−2.6	1,025	10	990	18
Halifax, Nova Scotia	1,016.3	−1.3	1,030	20	998	2
Nantucket	1,018.6	0.0	1,031	14	1,004	6
Hatteras	1,019.0	+1.0	1,028	14	1,006	23
Key West	1,014.6	+0.7	1,020	4	1,008	20
New Orleans	1,015.2	0.0	1,024	28	1,005	24

[1] For 16 days.

NOTE.—All data based on available observations, departures compiled from best available normals related to times of observation, except Hatteras, Key West, Nantucket, and New Orleans, which are 24-hour corrected means.

Extratropical cyclones and gales.—North Atlantic waters seem to have been scarcely more affected by LOWS other than those of tropical origin than they had been during August just preceding. There were a few fresh gales encountered either during the first week or about the end of the month, and one strong gale (force 9) was met on the morning of the 7th, near 37° N., 62° W., in the southeastern portion of an extensive LOW system which was advancing eastward from the continent over the ocean.

Tropical disturbances.—Four storms originating within the Tropics are discussed elsewhere in this REVIEW. Two of these affected mainly the Gulf of Mexico and lands adjacent, especially Texas, where they moved inland. The earlier of these, noticed from the 11th, when it was centered over the north-central Gulf, to the 15th, was relatively unimportant, the barometer readings apparently never being more than moderately low and the wind force probably nowhere greater than a fresh gale.

The second Gulf LOW was far more important, moving irregularly from the 18th, near Yucatan, to the 23d, near Matagorda Bay, Tex., and thereafter advancing swiftly north-northeastward over the land. It developed marked strength over the western Gulf of Mexico, where two vessels met winds of hurricane force.

During the life period of the second Gulf storm a vigorous tropical disturbance followed an unusual course, mainly to northward, then to eastward, off the coast of the South Atlantic States and the southernmost Middle Atlantic States. No hurricane winds (force 12) have been reported in connection with this storm, but the accompanying table shows that force 11 was noted by 4 vessels, 3 of these meeting the high winds well to eastward of the mainland coast in latitudes not far from 30°, while the other encountered the storm somewhat later, in the vicinity of Cape Hatteras.

The final tropical storm of September was followed from the 23d, near Barbados, till about the end of September, when it dissipated over Mexico. The waters affected by this disturbance were mostly southern and western portions of the Caribbean Sea. Vessel reports at hand indicate notable intensity for this storm over the Gulf of Honduras, on the 28th, one ship estimating the wind force it met as 12, and another estimating 11.

Fog.—But little fog has been reported, less than came to notice for August just preceding. The information at hand indicates occurence only over waters near the coasts of the Middle Atlantic and New England States and Nova Scotia, also they fail to show any fog whatever during the period 12th to 21st inclusive.

The 5°-square, 40° to 45° N., 65° to 70° W., leads all other squares, having fog on 4 days. Normally there are more than 10 days with fog in this square during September; past records indicate that no other Atlantic waters close to the North American coast have so much early autumn fog as this area.

On September 22 two steamships collided in New York harbor, during fog, with considerable damage resulting. During the night of the 25th–26th a vessel grounded near the south end of Block Island, probably because of fog.

OCEAN GALES AND STORMS, SEPTEMBER 1941

Vessel	Position at time of lowest barometer		Gale began September	Time of lowest barometer, September	Gale ended, September	Lowest barometer	Direction of wind when gale began	Direction and force of wind at time of lowest barometer	Direction of wind when gale ended	Direction and highest force of wind	Shifts of wind near time of lowest barometer
	Latitude	Longitude									
NORTH ATLANTIC OCEAN	° ′	° ′				*Millibars*					
A vessel	38 30N.	59 24W.	3	2p, 2	3	1,006.4	WNW	WNW, 5	NW	WNW, 8	W-WNW.
Do	36 54N.	62 18W.	6	4a, 7	7	1,010.5	SW	WSW, 7	NW	WSW, 9	WSW-NW.
Do	11 50N.	74 50W.	8	4a, 8	10	1,006.4	ENE	ENE, 5	E	ENE, 8	None.
Do	28 32N.	88 16W.	12	2p, 12	12	1,007.1	SE	E, 8	E	E, 8	S-E.
Do	28 06N.	90 18W.	12	6a, 13	13	1,002.7	E	N, 5	ENE	ENE, 8	ENE-NNW.
Do	25 54N.	86 00W.	18	6a, 19	19	1,009.1		ESE, 2		ESE, 8	
Do	28 32N.	74 17W.	19	2p, 19	21	1,001.7	SSW	Var., 2	W	NNE, 10	SSW-Var.—NE.
Do	30 30N.	70 42W.	19	4a, 20	22	1,003.4	SE	ENE, 10	ENE	E, 11	ESE-NE.
Do	[1] 30 11N.	71 42W.	19	4a, 20	20	1,006.4	ENE	E, 7	ENE	ENE, 8	
Do	30 00N.	70 10W.	20	6a, 20	22	995.3	ENE	SSW, 5	E	E, 9	SW-SSE-ENE.
Do	29 25N.	70 20W.	20	7a, 20	21	999.0	NE	S, 6	ENE	ENE, 10	S-NE.
Do	[1] 24 52N.	87 41W.	20	3p, 20	22	1,002.0	ENE	ESE, 8	E	E, 10	ENE-ESE-E.
Do	29 24N.	70 36W.	20	4p, 20	21	995.9	SW	SW, 7	ENE	ENE, 9	SW-E.
Do	25 54N.	85 42W.	17	4p, 20	21	1,006.4	E	E, 6	ESE	E, 8	
Do	29 42N.	70 24W.	20	5p, 20	22	997.6	E	ENE, 10	ENE	NE, 11	SSW-E-NE.
Do	28 12N.	71 12W.	20	2a, 21	21	1,000.0	E	NNW, 4	NNW	NE, 8	NNE-W.
Do	29 36N.	72 00W.	19	6a, 21	21	1,000.3	ESE	NE, 6	WSW	ENE, 11	ENE-NE-SW.
Do	26 42N.	88 24W.	20	4p, 21	22	1,001.7	ENE	E, 9	ESE	E, 9	
Do	26 43N.	87 50W.	21	4p, 21	22	1,002.4	E	E, 8	ESE	E, 9	E-ESE.
Do	26 40N.	87 55W.	20	4p, 21	22	1,004.4	ENE	ESE, 8	ESE	E, 9	ENE-ESE-E.
Do	32 18N.	75 00W.	21	6a, 22	22	1,002.0	NE	ENE, 5	W	NE, 9	NE-E.
Do	32 55N.	72 43W.	20	12m, 22	22	998.0	ENE	SSE, 9	SSW	SSE, 9	ESE-SSW.
Do	28 30N.	93 18W.	21	2p, 22	23	998.3	NE	E, 9	E	E, 9	NE-ESE.
Do	26 50N.	94 05W.	21	3p, 22	22	990.9	NE	NW, 7	SSE	NNW, 8	NNW-S.
Do	34 48N.	75 06W.	21	4p, 22	22	1,009.1	NE	NNE, 8	NNE	NNE, 8	
Do	[1] 33 12N.	72 58W.	22	4p, 22	22	1,000.0	SE	SE, 8	SW	SE, 8	E-SW.
Do	27 06N.	93 42W.	21	6p, 22	23	985.8	NE	E, 9	S	NE, 12	NE-SE.
Do	25 48N.	94 00W.	22	6p, 22	22	1,000.0		W, 5		NNW, 8	NW-SW.
Do	27 00N.	95 00W.	21	7p, 22	23	987.5	ENE	W, 5	S	N, 10	NNW-NE-WSW.
Do	[1] 34 13N.	75 09W.	21	8p, 22	23	1,004.7	E	NE, 5	NNW	E, 8	NE-NW.
Do	[1] 35 04N.	74 22W.	21	12p, 22	23	[2] 995.9	NE	N, 10	NE	N, 11	N-NE.
Do	34 08N.	75 30W.	21	4a, 23	23	1,005.8	NE	NNW, 8	NNW	N, 9	
Do	36 00N.	75 00W.	21	4p, 23	23	1,005.8	NE	NNW, 7	NNW	NE, 8	NNW-NNE.
Do	28 42N.	94 00W.	21	12p, 23	24	1,000.0	E	S, 12	WSW	S, 12	SSE-SW.
Do	15 20N.	81 50W.	27	12m, 27	27	1,000.3	ENE	E, 9	E	E, 9	ENE-E.
Do	16 00N.	86 48W.	27	8a, 28	28	992.9	NE	E, 2	SE	NE, 12	NE-E-ESE.
Do	16 00N.	87 24W.	28	10a, 28	28	996.6	N	SW, 6	E	SE, 11	NNW-SW-SE.
Do	16 16N.	87 43W.	28	11a, 28	28	997.0	N	SSE—	E	SSE, 8	NNE-SSE-SE.
Do	16 00N.	88 30W.		12m, 28		999.7		W, 9		W, 9	
Do	17 20N.	88 02W.	28	3p, 28	28	1,002.7	NE	E, 9	SE	E, 9	ENE-SE.
Do	39 00N.	47 00W.	30	3a, 30	30	1,009.5	S	S, 8		S, 8	S-W.
NORTH PACIFIC OCEAN											
A vessel	[1] 16 40N.	157 12E.	1	8a, 1	1	983.4	NW	W, 11	S	S, 11	NW-S.
Do	25 36N.	142 48E.	4	4a, 5	5	995.9	NE	WNW, 7	SE	WNW, 8	NNW-WSW.
Do	20 20N.	106 50W.	7	2p, 8	8	1,005.1	E	NE, 6	NNE	ENE, 8	ENE-NNE.
Do	20 42N.	107 30W.	9	7a, 9	9	1,001.4	N	NNW, 9	NW	NW, 10	NNE-NW.
Do	39 40N.	176 42E.	10	4a, 11	11	1,006.8	NE	NNE, 7	SSE	SSE, 8	NE-NNE-E.
Do	24 36N.	133 00E.	14	7a, 15	17	[2] 979.0	NE	NE, 10	S	S, 12	N-SE.
Do	[1] 56 03N.	137 01W.	15	4p, 15	15	993.9	W	NNW, 4	NW	W, 8	W-NE.
Do	[1] 22 32N.	116 32E.	13	5a, 16	17	983.7	NE	ESE, 12	S	NE, 12	ENE-SE.
Do	20 —N.	107 —W.	19	4p, 19	19	937.0	E	Var., 1	SW	SW, 12	NE-Var.-SW.
Do	22 21N.	110 07W.	20	4p, 20	20	992.2	NW	WNW, 11	SW	WNW, 11	NW-W.
Do	14 23N.	97 30W.	20	4a, 21	21	1,004.1	WNW	WNW, 6	W	WNW, 7	None.
Do	14 00N.	95 42W.	24	4p, 24	24	1,007.1	SW	SW, 7	SW	SW, 7	None.
Do	[1] 14 57N.	96 23W.	24	5p, 24	25	1,005.8	S	SW, 7	W	SW, 7	

[1] Position approximate. [2] Barometer uncorrected.

WEATHER ON THE NORTH PACIFIC OCEAN

By WILLIS E. HURD

Atmospheric pressure.—Following the condition of high pressure over the central Aleutians in August, there was a considerable barometric fall in September, and though the average readings at Dutch Harbor and St. Paul Island were above normal, the early autumn Aleutian LOW, pressure 1,009 millibars (29.80 inches), had become established.

From Juneau to Mazatlan, on the American coast, and at Honolulu, Midway Island, and Guam, pressures were below normal, unusually so at Honolulu, where the average, 1,012.5 millibars (29.90 inches) was 3.4 millibars (0.10 inch) below.

The North Pacific HIGH was central, during most of the month, principally to the northeastward of the Hawaiian Islands.

TABLE 1.—*Averages, departures, and extremes of atmospheric pressure (sea level) at selected stations for the North Pacific Ocean and its shores, September 1941*

Stations	Average pressure	Departure from normal	Highest	Date	Lowest	Date
	Millibars	*Millibars*	*Millibars*		*Millibars*	
Barrow [1]						
Dutch Harbor	1,009.0	+1.2	1,030	8, 9	988	28
St. Paul	1,009.3	+3.2	1,026	8	990	24
Juneau	1,011.9	−1.3	1,027	6	999	3
Tatoosh Island	1,015.2	−.7	1,028	21	996	10
San Francisco	1,012.2	−1.7	1,019	30	1,007	7
Mazatlan	1,008.0	−1.8	1,011	3, 28, 29	1,003	20
Honolulu	1,012.5	−3.4	1,017	29	1,009	8
Midway Island	1,014.8	−1.5	1,019	2	1,006	9
Guam	1,008.6	−1.6	1,014	10	1,005	2, 3, 26
Manila [1]						
Hong Kong	1,008.1	0.0	1,013	25	1,000	15

[1] Data insufficient for use.

NOTE.—Data based on 1 daily observation only, except those for Juneau, Tatoosh Island, San Francisco, and Honolulu, which are based on 2 observations. Departures are computed from best available normals related to time of observations.

Extratropical cyclones and gales.—While there was some movement of depressions in middle and higher latitudes, according to the rather limited ships' reports over a great area, stormy weather seems to have been extraordinarily infrequent for the season. Two gales were reported, both of force 8. One was experienced near 40° N., 177° E. on the 11th; the other west of southeastern Alaska on the 15th.

Tropical cyclones—Typhoons.—Subjoined is a report by the Rev. Bernard F. Doucette, S. J., Weather Bureau, Manila, P. I., on five typhoons and two depressions that occurred in the Far East during September.

Further, concerning the typhoon of the 7th to 17th, a vessel east of Hong Kong entered the fresh-gale area of the cyclone on the 14th and left it on the 16th. While the storm was changing its course and moving slowly, the observer reported that the "vessel was within the radius of hurricane force winds for 50 hours." The ship's lowest barometer was 983.7 millibars (29.05 inches) on the morning of the 16th, near 22½° N., 116½° E.

In connection with the typhoon of September 12–20, a vessel close to the center of the storm on the 15th, near 24½° N., 133° E., had an uncorrected barometer of 979 millibars (28.91 inches) and a northeast wind of force 10 at 7 a. m., followed by a hurricane wind from the south later in the day.

Cyclones west of Mexico.—While there are evidences of localized, unsettled weather conditions that threatened development into cyclones on other occasions, at least two hurricanes are known to have occurred in Mexican west coast waters, one on about the 8th to 12th; the other on about the 17th to 20th.

The earlier was first reported by a ship having a moderately depressed barometer on the 8th and a northeasterly gale of force 8, near 20° N., 107° W. On the 9th another vessel, a few miles to the northwestward, had a northwest gale of force 10, with lowest barometer at 1,001.4 millibars (29.57 inches). The storm was then moving slowly toward the Gulf of California. On the 13th a press report from Mexico City told of the destruction wrought by it. Quoting:

> The fiercest cyclone of this century for 48 hours, ending at noon yesterday, thrashed the southern end of the peninsula of Lower California. It demolished the towns of Santiago and Triunfo, causing 15 deaths and injuring many others. The wind, which reached an intensity of 85 miles an hour, completely demolished the poorer section of La Paz and razed villages near the city.
>
> The highways of Lower California are reported to have been seriously damaged by the torrential rains, which abated somewhat tonight, leaving estimated thousands homeless.

In reporting on the second hurricane, one vessel quoted radio messages as stating the storm was central in 12° N., 100° W., on the 17th and near 14° N., 101° W., on the 18th, while another disturbance was then near 15° N., 111° W. An advisory on the 19th said the two disturbances had merged into a storm of considerable intensity near 17° N., 105° W. The ship quoting the advisories headed into the strong easterly winds on the north of the disturbance at 8 a. m. ship's time, of the 19th. At 1 p. m. the squalls became heavy and the barometer was falling rapidly, and at 2 p. m., amid hurricane gusts and practically zero visibility, some damage was done to the ship. Between 2:30 and 4 p. m. said the report of the second officer:

> The barometer fell so rapidly that it could be seen moving down—from 29.25 to 27.67. At 4:30 the ship passed through the center of the cyclone. The wind died down to almost 0 and the low clouds opened up so that high cirrus could be seen through a small opening. There was a peculiar yellow light and the sea became bright green in color. The extremely low atmospheric pressure caused discomfort in the ears. High confused swells broke aboard the ship with terrific force from all sides. In about 10 to 15 minutes the center passed and the wind came from the southwest, force 12 and over.

The reading 27.67 inches, occurring in 20° N., 107° W., is the second lowest barometer recorded in any hurricane in these waters. The lowest reading, 27.45 inches, occurred in the hurricane of October 25, 1939, in practically the same position, about 20° N., 106° W.

The storm advanced into the Gulf of California on the 20th, and at 4 p. m. of that date a vessel near 22° N., 110° W., had a west-northwest gale of force 11, barometer 992.2 millibars (29.30 inches). Nothing is known definitely regarding the subsequent history of the cyclone.

On the 21st and 24th westerly winds of force 7, with some barometric depression, south to southwest of the Gulf of Tehuantepec, indicate further disturbed weather, although accompanied by no known cyclonic development.

Fog.—Scattered fogs occurred in higher latitudes of the Pacific, but the only interesting occurrence is that of a vessel that entered fog on the 14th near 45° N., 170° E., remained in it without a break for two or three days, then observed it intermittently until the 19th, near 46° N., 162° W. Fog was reported on 4 days off the Oregon coast and on 13 days off the California coast.

TYPHOONS AND DEPRESSIONS OVER THE FAR EAST

Bernard F. Doucette, S. J.

[Weather Bureau, Manila, P. I.]

Typhoon, August 31—September 5, 1941.—The first indications of the formation of this storm were the pressure falls at stations along the eastern coast of Luzon, namely the regions about 60 or 70 miles northeast of Manila. On the morning weather map of August 31 there were certain signs of a typhoon forming rather close to the coast, or perhaps one that had formed some distance away and was moving rapidly toward Luzon. In the afternoon, the observations clearly showed the storm center to be about 60 miles east of Baler, Tayabas Province, small, but moving rapidly. During the night the center crossed Luzon, passing south of Casiguran and north of Baler, (both in Tayabas Province) north of Cabanatuan, North Ecija Province, and entered the China Sea via Lingayen Gulf, moving between Dagupan, Pangasinan Province, and Baguio, Mountain Province. Over the China Sea, the storm moved west-northwest, then west, to Hainan Island. Here it changed to the northwest, crossed the Gulf of Tong King, and disappeared over the continent on September 5.

Over the Philippines, August 31, the stations along the course of the storm reported pressure values between 747 mm. (995.9 mb.) and 750 mm. (999.9 mb.) with winds rather weak, considering the situation, the highest being force 6. This is due most likely to the sheltering effect of the mountains. No serious damage was reported, nor were any casualties mentioned in the Manila newspapers.

The upper winds over Cebu and Zamboanga were from the southwest and west quadrants, with velocities seldom reaching 30 k. p. h. Over Manila, the southwesterly current was as high as 45 k. p. h. on August 31 and September 1. Dagupan reported northwesterly winds up to 100 k. p. h. August 31, afternoon ascent, which was the only ascent possible during the course of the storm over Luzon. On September 1, Aparri, Cagayan Province, had winds aloft from the southeast quadrant with velocities as high as 100 k. p. h. These pilots indicate that there was much more activity aloft than at the surface stations protected by neighboring hills and mountains.

Typhoon, September 1-7, 1941.—This typhoon is supposed to have formed far to the east of the eastern Caroline Islands, and then moved along a northwesterly course. At the observatory, the first knowledge of its existence came with the following observation and message, dated September 1 from a ship:

0015 G. C. T., position 17° N. 157° 55′ E., bar. 29.30 rising; wind estimated 90 miles per hour, varying southwest to south; mountainous seas; heavy rain; passed through center 2130 G. C. T., barometer 29.10 at center.

From this day on, there were no observations available to locate the storm center. Then, on September 4 and 5, Bonin Islands came under the influence of the storm, and observations showed that the course was changing from northwesterly to northerly, the center passing about 60 miles northeast of the station during the forenoon of September 5. The storm then moved very rapidly toward the ocean regions east of central and northern Japan, recurved to the north-northeast and passed beyond the region of observation September 7. The lowest pressure value reported from the Bonins was 743.5 mm. (990.7 mb.), September 5, 5 a. m. (Manila time), with wind force 12, from the northwest. A ship came under the influence of this typhoon. The minimum pressure experienced was 739.9 mm. (986.5 mb.) near latitude 34°43′N., longitude 146°43′E., with south-southeast winds of force 11, September 6, 5 a. m. ship's time.

Depression, September 1-5, 1941.—A low-pressure area moved northwesterly from the regions between Guam and Yap to a position about 450 miles east-northeast of San Bernardino Strait, where, as a depression, it inclined to the north and disappeared. It was a storm of minor importance according to available data.

Typhoon, September 7-17, 1941.—A low-pressure area, which appeared about 300 miles west of Guam, September 7, moved westerly and quickly intensified to typhoon strength on September 9, when about 500 miles east of San Bernardino Strait. Moving northwesterly, it reached a position almost directly east of the Balingtang Channel, and then it shifted to a westerly course inclining to the west-southwest and southwest as the center approached Luzon. September 12, during the forenoon and afternoon, the storm crossed northern Luzon, and changed its course to the west-northwest as it entered the China Sea about 30 miles south of Vigan, Ilocos Sur. Then it progressed across the China Sea, moving west-northwest and, inclining to the north-northwest, reached the locality of Hong Kong. The storm seemed to be about to enter the continent close to and east of Hong Kong, but a sudden shift of its course to the west carried the center close to and south of the colony (September 16). On September 17, there were slight indications of the typhoon about 200 miles west-northwest of Hong Kong and on September 18 it was certain that the storm had disappeared over the continent.

Over northern Luzon, September 12, pressure values had fallen to 747 mm. (995.9 mb.) with weak winds, that is, force 3, 4, and 5. The usual weakening of a storm center as it passed over the mountains, was evident and the stations, reporting from sheltered localities, had only pressure values to indicate that the storm was powerful. There were no lives lost; at least there were none reported in the newspapers. Considerable damage by rain to crops, partly matured, was reported. On September 16, when the center was close to Hong Kong, 742.1 mm. (989.4 mb.) was the lowest value received for synoptic purposes. (The real minimum value had not been received at Manila at the time this article was prepared.) Hurricane winds in Hong Kong harbor caused four ships to be beached, and the loss of a few lives, almost all of these casualties occurring near the shores where the high waves flooded the streets.

Upper winds over Philippine stations were similar to those during the typhoon of August 31–September 5. Cebu and Zamboanga were reporting winds from the southwest quadrant, but the velocities increased to values as high as 100 k. p. h. at Cebu on September 12, but at Zamboanga 55 k. p. h. was the maximum, September 11. In general, Zamboanga was much weaker than Cebu during the period under consideration. Manila had velocities of 115 k. p. h. on September 13, when the typhoon was over the China Sea. Dagupan and Aparri reported very few ascents during these days, because of poor weather conditions. Stations of Indochina and Thailand reporting during this typhoon indicated that the southwesterly current over the southern part of the China Sea was weak, hardly ever reaching values of 50 k. p. h. Also, the reports from northern Indochina seem to show that there was a strong northerly current flowing from the interior of China. This is probably due to the typhoon center near the Nansei Islands at the time (typhoon, September 12–20) which was quite deep, and coastal stations indicated a vigorous flow of air from the north. This current of air seems to have been the controlling factor with regard to the shifting of the course of the typhoon center over the northern part of the China Sea, as it approached and passed Hong Kong.

Typhoon, September 12-20, 1941.—A weak low-pressure area appeared west of the Mariana Islands on September 12, and moved northwesterly. On September 15, it had intensified to typhoon strength (which may have occurred before, but no data have been received to indicate it). This typhoon moved slowly along a north-northwesterly course toward the locality of Borodine Island (Nansei Islands) where it recurved to the northeast. It moved rapidly along this course and was beyond the region of observation September 20. On September 16, 2 p. m. (Manila time), Borodine Island reported a barometer of 732 mm. (975.9 mb.) with north-northeast winds force 5. This observation was made when the center was close to and east of the station, just about to recurve. During these days (September 14 and following) there was a vigorous northerly current over China with considerable rise of pressure, most likely a preliminary tendency toward the formation of the Siberian HIGH.

Depression, September 24-29, 1941.—This depression formed about 450 miles east of Surigao Strait, moved west-northwest to Samar Island, and then moved across the Visayan Islands along a westerly course. It inclined to the northwest in the China Sea and disappeared over the regions 300 miles west of central Luzon. It was a storm of minor importance throughout its course.

Typhoon, September 24–October 3, 1941.—There seemed to be a low pressure area far to the southeast of Guam during the few days before September 25, on which date the morning weather map had definite evidence of a depression central about 300 miles south of Guam. This disturbance moved along a west-northwesterly course, becoming a typhoon on September 26. When the center was about 500 miles east of northern Luzon, near latitude 18° N., longitude 131° E., it shifted its movement to a northerly course (September 29), and rapidly approached Kiusiu Island. It crossed this island October 1 and then recurved to the northeast, passing over northern Japan October 2 on its way to the regions south of the Aleutian Islands.

This disturbance was known to be severe on September 27, when a ship reported from latitude 12°54′ N., longitude 139°54′ E., a pressure of 747.1 mm. (996.0 mb.) with south-

east winds force 8. When the center was over Kiusiu Island, October 1, the afternoon observations from Miyazaki were 728.0 mm. (970.6 mb.) with southeast winds force 9, and from Kagoshima, 727.0 mm. (969.3 mb.) with northwest winds force 6. Newspaper reports in the Manila press of October 2, had an account of the loss of 100 lives in Kiusiu Island due to the typhoon. Many more, fishermen mostly, were missing and a greater total was expected. Property damage amounted to many millions of yen.

The upper winds over Guam were from the east quadrant September 22 and following days, veering to the southeast and increasing to values between 30 and 60 k. p. h. September 25 to 27, as the center passed southwest of the station. Over the Philippines, Aparri, Dagupan, and Manila remained in an easterly (sometimes northeasterly) current until September 30. Cebu and Zamboanga, however, were always reporting winds aloft from the northwest and west quadrants, velocities below 35 k. p. h. until September 28, when an increase to values as high as 70 k. p. h. from the southwest quadrant took place. These high velocities were reported from Cebu more than from Zamboanga, the latter station being consistently in a weaker air stream than Cebu. On these days, September 27 and following, there was a vigorous north quadrant current over China and the northern part of the China Sea. It was also manifested in a few ascents reported from stations of northern Indochina. From the few reports received from Thailand, it seems that these velocities of 50 k. p. h. and higher did not prevail over the southern part of the China Sea and adjacent regions. There was enough evidence during these days to show that two currents of air were interacting over the China Sea, which resulted in the formation of a secondary disturbance described below.

Typhoon, September 30–October 2, 1941.—The first information of this typhoon was the report sent by a ship on September 30, 8 a. m. (Manila time) from latitude 12°17 ′N., longitude 118°58′ E., pressure 741.8 mm. (988. 9 mb.) and east winds, force 8. At the same time, Culion, Palawan Province, about 80 miles away, had values varying between 752 and 754 mm. (1,000.5 and 1,005.0 mb.) following the normal daily oscillation. This small typhoon moved northerly about 200 miles and inclined to the northeast as it entered central Luzon over the southern part of Zambales Province. It was weakening as this happened (afternoon hours, October 1), and became a rather shallow depression as it moved over the plains of central Luzon. Over the Pacific Ocean, it moved either east-northeast or northeast to the regions about 200 miles east of Balingtang Channel, where it disappeared.

The storm was violent over a small area and caused considerable damage to the western shores of Mindoro Island and Batangas Province. At Calatagan, Batangas Pr. (a town about 5 miles north of Cape Santiago, Verde Island Passage), the pressure fell to 738 mm. (983.9 mb.) about 5 a. m. October 1. The winds were always from the west, with no lull, and increasing from 1 a. m. to 5 a. m., then decreasing after 6 a. m.

This typhoon weakened quickly because of two reasons. The first reason was the topography, namely the mountains and hills of Zambales Province. The other reason was the deflection of the northerly current of air, flooding the China Sea, into the southern part of the typhoon circulation. This checked the flow of air from the southern part of the China Sea, which was weak, as explained in the previous typhoon account.

Two lives were lost because of this typhoon. Considerable property damage resulted because of the winds and the rain (90 percent of the houses at Calatagan were destroyed), and two rather large ocean-going vessels suffered damage when they were blown ashore.

RIVER STAGES AND FLOODS

By BENNETT SWENSON

Outstanding during September was the continued drought in Eastern States and the continuation of above-normal precipitation west of the Mississippi River. River stages were unusually low in most sections east of the Mississippi River, and in some cases approached or exceeded the lowest stages of record. On the other hand, stages were above normal in most western sections with floods occurring in a belt extending from southeastern New Mexico northeastward to Minnesota and northern Wisconsin. Noteworthy were the damaging floods which occurred in the Pecos River and the Rio Hondo in the vicinity of Carlsbad and Roswell, N. Mex., the rivers and streams in northern Wisconsin, and in portions of the Solomon, Big Blue, Smoky Hill, and Neosho Rivers in Kansas. Floods occurred also in the Canadian River in New Mexico and Oklahoma, the Republican River in Nebraska and Kansas, and rivers and streams in northeastern and southwestern Iowa, and southeastern Nebraska.

Atlantic Slope drainage.—River stages were unusually low, approaching, or exceeding, the lowest stages of record in many cases, due to the drought conditions.

The stages in the Susquehanna River approached the lowest of record, but did not equal or exceed the lowest in 30 or 40 years of record. The Delaware River at Trenton, N. J., was below zero from September 13 to the end of the month. In the south, the rivers of the Altamaha system were low throughout the month. At Charlotte, Ga., the Altamaha River reached a low stage of only 0.5 foot above the lowest stage of record, while at Doctortown, Ga., it equaled the lowest of record, −2.3 feet. At Dublin, Ga., the Oconee River reached a stage of 0.7 foot, just 0.1 foot above the lowest of record.

Ohio Basin.—The Tennessee River was low and, under control of the Tennessee Valley Authority dam system, the range in stage at Johnsonville, Tenn., was only 1.7 feet (2.3 to 4.0 feet). The precipitation recorded at Asheville, N. C., during September, 0.28 inch, was the lowest of record. In the Ohio River, the dams were up generally throughout the month.

Upper Mississippi Basin.—Exceptionally heavy rains on August 29, 30, and 31, in the upper Chippewa and Wisconsin River Basins and also in the Lake Superior drainage in northern Wisconsin, resulted in devastating floods in that area. Maximum stages of record were exceeded in the upper Chippewa and the extreme upper Wisconsin River basins. Total losses from the flooding in the Chippewa Basin alone have been estimated at more than $1,000,000. The La Crosse, Wis., office makes the following comments on the flood in the Chippewa River:

Source of Flood.—On August 29, 30, and 31, excessive and unusually heavy rains fell in the upper Chippewa Basin with maximum intensity and focal point in the northeastern part of Sawyer County. Rains of 60-hour duration in this particular locality amounted to more than half the average season precipitation. An average of over 10 inches fell in Sawyer County and approximately 15 inches in the most intense area. In the lower Chippewa Valley the rains from Durand, Wis., to the mouth of the river were comparatively light. The heavy rain area extended eastward into the upper Wisconsin drainage area and westward into the upper St. Croix Basin. The arithmetical average of 33 stations in the Chippewa drainage of 9,010 square miles was 7.00 inches for a period of 3 days. Approximately 500 square miles received 14 inches; 600 square miles, 12 inches; 600 square miles, 10 inches; 1,500 square

miles, 8 inches; 4,000 square miles, 6 inches; 1,000 square miles, 4 inches; and 800 square miles, 2 inches.

The heaviest downpour of rain occurred in what is known as the "resort" area of Wisconsin where many vacationists were spending the week end and following Labor Day holiday. Many of these were temporarily stranded by washouts on the highways.

Attendant meteorological factors.—The synoptic map of August 30th shows a tongue of warm moist tropical air extending up the Mississippi Valley into Wisconsin with a warm front running from Minneapolis eastward into central Michigan. North of Lake Superior there was a mixture of maritime polar, continental, and tropical air masses. It is thought that cold air moving from the northwest over the cold waters of Lake Superior formed a wedge and uplifted the moist air adjacent to the south shore of the lake, thus producing heavy condensation and torrential rains. The effect was no doubt intensified by the retarding action of a large high pressure area over the eastern part of the country resulting in an almost stationary low pressure system in the upper Mississippi Valley. An occasion of this nature may be regarded as extremely rare as maximum 24-hour rainfall amounts appeared to exceed all previous records.

Hydrologic factors.—This statement is substantiated by the fact that the U. S. Geological Survey secured the high all time records of flow at Bishop's Bridge and several other streams in the upper reaches of the Chippewa. This was also true for the extreme upper Wisconsin drainage.

A peculiar feature of this flood was that it came at a time when the streams were at extreme base ground flow and rather droughty conditions prevailing. The pasture lands in the lower Chippewa were parched and turning yellow. Cultivated fields were dry and dusty and although the surface was baked and rather hard, conditions were such as to favor a large initial loss with steady and light rainfall. The rains fell at such a maximum rate that they did not have time to percolate into the ground and of such intensity that the damage was considerable in areas far removed from the actual flood plane of the streams. The extreme upper reaches of the Chippewa were focal points of heaviest rainfall, such as the White and Bad Rivers adjacent to the divide, the north slope of which drains into Lake Superior.

The maximum instantaneous peak at Durand, Wis., was 15.45 feet at 4 p. m. of September 2d. The last extreme flood was in September 1928, when the highest stage was 15.2 feet.

Historic floods.—The maximum flood previous to this was in June 1905 when the peak stage was 19 feet at Durand. Previous to this there was a flood in the Chippewa of Sept. 11, 1884, with a stage of 27 feet at Eau Claire, Wis. (no record at Durand at this time). This appeared to be the only one exceeding the damage of the present one, which was also greater than the flood of June 1880. Records from the old lumbering days show that an extreme flood occurred in June 1847 when all the sawmills along the river were swept away.

Damages.—Damages for this flood were confined to the Chippewa drainage area proper. The St. Croix River received some share of the flood volume but so far as can be determined at this time, the damage in that basin was slight. In the Chippewa Valley an accurate estimate of damages cannot be made until reconstruction is completed. However, it is safe to assume that the total damage will closely approach $1,500,000. The hardest hit counties were Eau Claire, Chippewa, Price, Lincoln, Washburn, Ashland, and Sawyer. Damage by excessive rains outside of the flood plain would exceed $750,000 in Sawyer, Oneida, Washburn, and Ashland counties. Federal aid was requested for 1,600 families temporarily driven from their homes by the flood waters. At Chippewa Falls, Wis., the river normally 300 feet wide, formed a lake one-half mile in width. Eau Claire and Chippewa Falls suffered the greatest flood loss. In the Indian village of Odanah (extreme upper Chippewa Basin) about 225 families were forced to vacate their homes. The damage to bridges and highways was considerable all through the Chippewa Valley. Railroad traffic was closed from Eau Claire to Wabasha, Minn., and many of the highways entering Eau Claire and Chippewa Falls were under water.

The highway traffic over the Chippewa at Durand was closed with about one-half mile of highway washed out on the north shore side. Some highway and construction projects at Eau Claire had to be abandoned and some of the structure swept away by the flood. Damage to bridges and highways will exceed $250,000. In Eau Claire 300 homes were isolated by the flood and about 100 in Chippewa Falls. Red Cross aid was given to the homeless.

The total damages of the Chippewa flood have been estimated as follows;

Tangible property:	
Eau Claire and vicinity	$75,000
Hayward and vicinity	100,000
Chippewa Falls and vicinity	150,000
Durand and vicinity	15,000
Outside these cities	500,000
Construction projects and dams	110,000
Total	950,000
Agricultural losses:	
Matured crops	20,000
Prospective crops	10,000
Livestock and other movable farm property	10,000
Total	40,000
Suspension of business	10,000
Total known losses	1,000,000
Value of warnings	250,000

Warnings issued.—On August 30 the first reports of excessive rains were telephoned to the Weather Bureau. The flood-producing rains were confined to the upper reaches of the Chippewa drainage area, and cautionary warnings were telegraphed to Durand and Eau Claire. A special stage observation was telegraphed from Holcombe, Wis., showing an exceptionally large rise. With further reports of excessive rains received the following morning, the severity of the impending flood was conclusively determined. Warnings of severe flood were then again telegraphed to the radio station at Eau Claire and the observer at Durand with instructions to have the telephone operators call interested parties and especially those living in the bottom lands. Warnings were broadcast every half hour from the radio station on August 31. Residents of Chippewa Falls and Eau Claire had 60 hours advance information of the flood and about 72 hours in Durand and the lower Valley where numerous herds of cattle were pastured. The chief dispatcher of the Northern States Power Co. at Eau Claire deserves appropriate credit both for telegraphing this office the necessary hydrologic information upon which to base the flood warnings as well as for giving out complete information of flood conditions to all parties calling their office.

Additional heavy rains occurred during September in the Minnesota, Wisconsin, and Iowa area, principally during the periods 8th–10th and 15th–16th. The rains during the first of these periods augmented the flow in the Chippewa River so that the crest reached La Crosse, Wis., on the 11th, at a stage of 9.8 feet. The rains of the 15th–16th did not produce a secondary crest at La Crosse, but served to continue the high water throughout the month in the Mississippi River. A large volume of water in the river from above St. Paul, Minn., moving down from the 17th to the 20th and reaching a stage of 9.2 feet at Hastings, Minn., was also a factor in maintaining the high water.

The rainfall on the night of the 15–16th, was exceptionally heavy in the vicinity of La Crosse. On the morning of the 16th, Sparta, Wis., in the La Crosse River drainage, reported 4.03 inches of rain in 24 hours. From the same storm, a flash flood occurred in Coon Creek (8 miles south of La Crosse on the Wisconsin side). Two recording precipitation gages in the upper Coon Creek area, operated by the Soil Conservation Service, reported over 4 inches in 1 hour. This rainfall resulted in a sharp rise in the creek causing considerable damage to railroads and highways. The total damage is estimated at more than $30,000 and about the same amount of loss was sustained in Monroe County, especially near Sparta, Wis. Some flooding of the lowlands occurred in the Root and Whitewater Rivers, tributaries of the Mississippi in the vicinity of La Crosse on the Minnesota side.

The floods in the Wisconsin River were most severe in the upper portion following the heavy rains of August 29–31. The river reached a crest of 20.5 feet at Knowlton, Wis., at midnight of September 1–2. The previous high floods of which there are records were in July 1912, April 1922, and September 1938, when stages of 19.9, 19.5, and 19.9 feet, respectively, were reached on the Knowlton gage. The crest flattened out downstream and at Wisconsin Rapids and Portage, Wis., the river was only slightly above bankful.

Two other crests occurred at Knowlton, namely on the 6th and 17th from additional rains. These rises, however, were well below the first rise, and resulted in no appreciable further damage.

The total losses from the floods in the Wisconsin River valley have been estimated at about $300,000.

Heavy to excessive rains occurred over a narrow belt, in east central Iowa, crossing the Wapsipinicon and Maquoketa River valleys on September 7–9. Local amounts for a 72-hour period exceeded 7 inches in several counties and for the counties in the Iowa, Cedar, Wapsipinicon, and Maquoketa River basins the daily averages have been computed as follows: 7th, 0.60 inch; 8th, 2.98 inches; 9th, 0.42 inch.

Moderate floods resulted in the Wapsipinicon and Maquoketa Rivers and local overflows along the lower Cedar and Rock Rivers. The damages in the first two mentioned rivers amounted to an estimated total of $640,000.

Missouri River Basin.—Overflows occurred in the Blue, Solomon, Republican, Saline, and Smoky Hill Rivers during the month with a total estimated damage of approximately $130,000. The overflow in the Republican River was slight and no appreciable damage occurred in that basin. The Topeka, Kans., office reports as follows on the floods in Kansas:

> The overflow in the basin of the Blue River occurred from the 15th to the 19th of the month. Both the Big Blue and the Little Blue overflowed rather badly. At Beatrice, Nebr., a crest stage of 26.3 feet, 10.3 feet above bankful, occurred on the 16th. At Blue Rapids a crest stage of 28.56 feet, 8.56 feet above bankful, occurred on the 18th. At Randolph a crest of 24.1 feet, 4.1 feet above bankful, occurred on the 19th. Along the Little Blue River the crest stages were from 2 to 3 feet above bankful.
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> The Solomon River reached a crest of 28.9 feet, 10.9 feet above bankful, at Beloit on the 5th. At Niles the crest was 24.6 feet, which was only 0.6 foot above bankful, and occurred on the 16th.
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> The overflow along the Smoky Hill River proved rather serious. At Lindsborg a crest of 28.3 feet, 7.3 feet above bankful, occurred on the 4th; at Salina a crest of 22.7 feet, 2.7 feet above bankful, occurred on the 6th; and at Enterprise a crest of 26.8 feet, 0.8 foot above bankful, occurred on the 9th.

Arkansas River Basin.—Moderate to severe flooding occurred in the Cottonwood and Neosho Rivers in Kansas. The Cottonwood River reached a stage of 25.4 feet at Emporia, 5.4 feet above bankful, on the 7th. In the Neosho River, the flooding was more pronounced in the reach from Iola, Kans., to the Oklahoma line. At Iola, the crest was 20.5 feet, 5.5 feet above bankful, on the 6th. The crest moved downstream, reaching Chanute, Kans., on the 8th with a stage of 26.0 feet, 6 feet above bankful; Parsons, Kans., on the 11th, with a stage of 26.2 feet, 4.2 feet above bankful; and Oswego, Kans., on the 11th with a stage of 23.0 feet, 6 feet above bankful. The overflow at Parsons and Oswego extended over a period of 7 to 8 days. The total damages from the flooding in the Cottonwood and Neosho Rivers in Kansas is estimated at approximately $275,000.

Excessive rains in the upper watershed of the Walnut River and in the Whitewater Creek area in Kansas caused an overflow in the two streams from September 1–4. The flood waters moved down the Walnut River to Arkansas City, Kans., but the only damage reported was in Butler County, in the vicinity of Augusta, Kans., and above; the high water, to the extent of damaging proportions, reached Augusta late on the 3d. Warnings were issued on the morning of the 3d. The damage from the high water in Butler County was estimated by the county engineer at $176,500 and a saving from warnings of $25,000 was reported.

The Canadian Rivers overflowed from frequent rains during the month in northeastern New Mexico, the Texas Panhandle, and Oklahoma. At Woodward and Canton, Okla., the North Canadian River was above flood stage on the 25th and 26th, while at Yukon, Okla., the river exceeded flood stage from September 2 and was still in flood at the close of the month. The crest at the latter place was reached on the 28th, with a stage of 13 feet. At Canadian, Tex., and Union City, Okla., the Canadian River was from 2 to 3 feet above bankful on September 24–25.

West Gulf of Mexico drainage.—Floods occurred in Texas and New Mexico, principally in the Pecos River at and below Roswell, N. Mex., the lower Rio Grande, and in the lower Nueces River at and below Three Rivers, Tex. The latter stream was in flood at Three Rivers from the 18th to the 21st, with a peak stage of 41.4 feet (flood stage, 37 feet) on the 19th.

Precipitation was phenomenally heavy in New Mexico, and disastrous floods occurred in the Rio Hondo and in the Pecos River. The following is quoted from the general summary of the New Mexico Climatological Data for September:

> The month was the wettest of the entire half century of State-wide weather records in New Mexico. Precipitation averaged 5.97 inches; over 4 inches above normal, 1.63 inches wetter than any previous September, and 1.14 inches more than July 1914, the previous record wet month. All watersheds received above normal rainfall, with departures ranging from +1.69 in the San Juan and Northern Rio Grande to +6.23 in the Pecos Valley. The phenomenal rainfall was the result of two storm periods, the 20th to the 23d, and the 28th–29th. The former was confined principally to the east and south-central portions of the State, where several serious flash floods occurred; the principal one at Carlsbad, between 8 and 9 o'clock on the evening of the 20th, where 11 persons were drowned and property loss was large. This flood exceeded the one on May 21, but people had not been allowed to resettle in the ordinarily dry Dark Canyon Creek bed, a move which undoubtedly saved many lives. An unofficial but reliable rainfall measurement at the head of Dark Canyon indicated 17 inches of rainfall from Saturday noon, 20th, to 6 p. m. of the 21st, and 10 inches of that amount in the 6 hours ending at 6 p. m. of the 20th. Much of Roswell was inundated on the 22d to the 24th from Rio Hondo floodwater and all western tributaries of the Pecos experienced damaging floods; crops, highways, and bridges being most severely damaged. The second storm period, the 28th–29th, was a general, heavy rainstorm which overspread the entire State with some important damage along the Gila River to highways and bridges, and another more serious inundation at Roswell which continued from the 29th into the first days of October. Total loss of life due to floods was 15, and property losses will run into several hundred thousands of dollars, possibly over a million.
>
> This month climaxed the period of abnormal wetness which commenced in the autumn of 1940, bringing the average precipitation for the past 12 months to 27.55 inches, and for the first 9 months of 1941 to 24.01 inches. This latter figure exceeds by over

3 inches the annual precipitation for 1904 and 1919, the wettest years of record.

The peak of the high water in the Pecos River reached Pecos, Tex., on September 30 with a stage somewhat in excess of 14.9 feet, flooding east Pecos.

In the Rio Grande, flood stages were exceeded at a number of places from Del Rio, Tex., to the mouth during the month. At Del Rio a crest of 17.3 feet was reached on September 18, and at Eagle Pass, Tex., a crest stage of 19.7 feet on the 19th. In the extreme lower Rio Grande from Mercedes, Tex., to the mouth the river was above the flood level from the 11th to the 24th. However, very little water overflowed on the American side of the river, being held back by private levees. No appreciable damage resulted.

Gulf of California drainage.—The storm of the 28th–29th brought heavy rains in the tributaries of the upper Gila River above Coolidge Dam and caused one of the worst floods ever experienced in Duncan, Ariz. and vicinity, and high water in the Safford, Ariz., area. The crest of the flood reached Duncan on the evening of the 29th, inundating a large part of the residential areas and farm land. Damages to homes, crops, and farm land along the Gila from Duncan to Coolidge Dam have been conservatively estimated at $500,000.

A more complete report of the floods in New Mexico and Arizona will be given in a later issue of the REVIEW.

ESTIMATED FLOOD LOSSES AND SAVINGS FOR SEPTEMBER 1941

River and drainage	Tangible property	Matured crops	Prospective crops	Livestock and other movable farm property	Suspension of business	Total losses	Total savings
Upper Mississippi Basin							
Chippewa River	$950,000	$20,000	$10,000	$10,000	$10,000	$1,000,000	$250,000
LaCrosse River and Coon Creek (Monroe and LaCrosse Counties, Wis.)	65,000		1,000			66,000	5,000
Wisconsin River	250,000	16,600	2,200	450	21,700	290,950	66,000
Wapsipinicon and Maquoketa Rivers (Iowa)	128,000	165,000	337,000	10,000	1,000	641,000	2,000
Missouri Basin							
Solomon River	9,500	4,500	13,000	500		27,500	5,000
Smoky Hill River	7,000	13,000	6,000	9,000	3,100	38,100	2,000
Big Blue River	2,500	35,000	25,000	1,000	2,000	65,500	23,000
Arkansas Basin							
Cottonwood River	56,500	37,000	14,500	4,000	2,500	114,500	11,500
Neosho River	50,000	48,000	55,000	5,000	1,200	159,200	20,000
Walnut River	75,000	90,000	10,000	1,000	500	176,500	25,000
WEST GULF OF MEXICO							
Pecos River [1]						[2] 1,000,000	
GULF OF CALIFORNIA							
Gila River						500,000	

[1] 15 lives lost.
[2] Incomplete.

FLOOD-STAGE REPORT, SEPTEMBER 1941

[All dates in September unless otherwise specified]

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
MISSISSIPPI SYSTEM					
Upper Mississippi Basin					
Chippewa:	*Feet*			*Feet*	
Holcombe, Wis	22	Aug. 30	8	31.6	1
Durand, Wis	11	2	7	15.45	2
Whitewater: Beaver, Minn		16	16	89.9	16
Wisconsin:					
Knowlton, Wis	12	Aug. 31	3	20.5	1–2
		5	6	13.0	6
		17	17	12.2	17
Wisconsin Rapids, Wis	12	2	3	[1] 12.8	3
Portage, Wis	17	6	6	17.3	6
Maquoketa: Maquoketa, Iowa		8	10	22.1	10
Wapsipinicon: DeWitt, Iowa	8	12	15	10.1	14
Iowa: Iowa City, Iowa	8	8	8	8.45	8
Mississippi:					
Le Claire, Iowa	10	10	12	10.1	11
		14	18	10.3	16
Louisiana, Mo	12	(2)	(2)	12.2	8–9
				12.4	19–20
Missouri Basin					
Solomon:					
Beloit, Kans	18	4	7	28.9	5
		15	17	24.6	16
Niles, Kans	24	9	10	24.4	10
Saline: Tescott, Kans	25	4	7	27.4	7
Smoky Hill:					
Ellsworth, Kans	20	2	2	21.35	2
Lindsborg, Kans	21	2	5	28.3	4
Salina, Kans	20	4	7	22.7	6
Enterprise, Kans	26	8	10	26.85	9
Republican:					
Guide Rock, Nebr	9	5	5	9.4	5
Scandia, Kans	10	15	15	10.6	15
Concordia, Kans	8	15	15	8.2	15
Clay Center, Kans	15	16	16	15.3	16
Little Blue:					
Endicott, Nebr	11	15	17	14.7	16
Hanover, Kans	14	16	18	18.5	17
Big Blue:					
Beatrice, Nebr	16	15	17	26.3	16
Barnston, Nebr	18	15	18	27.3	16
Blue Rapids, Kans	20	16	18	28.6	18
Randolph, Kans	20	17	19	24.1	19
Osage: Lakeside, Mo	60	14	15	60.0	14–15
		18	18	60.0	18
Arkansas Basin					
Cottonwood: Emporia, Kans	20	6	11	25.4	7
Neosho:					
Neosho Rapids, Kans	22	8	11	23.7	10
Le Roy, Kans	23	10	13	23.9	12
Iola, Kans	15	6	13	[3] 20.5	[3] 6
Chanute, Kans	20	7	14	26.0	8
Parsons, Kans	22	8	16	26.2	11
Oswego, Kans	17	8	16	23.0	11
North Canadian:					
Woodward, Okla	5	25	25	5.2	25
Canton, Okla	9	25	26	9.4	26
Yukon, Okla	8	2	(4)	13.0	28
Canadian:					
Canadian, Tex	5	23	25	7.0	24
		30	30	5.0	30
Union, Okla	6	24	25	8.6	25
WEST GULF OF MEXICO DRAINAGE					
Nueces: Three Rivers, Tex	37	18	21	41.4	19
Pecos: Pecos, Tex	13	24	(4)	[5] 14.9	30
Rio Grande:					
Del Rio, Tex	15	18	18	17.3	18
Eagle Pass, Tex	16	19	19	19.7	19
Rio Grande City, Tex	21	11	11	21.6	11
Mercedes, Tex	21	12	14	22.6	13
		22	24	22.2	23
Brownsville, Tex	18	23	24	18.2	24

[1] Approximate.
[2] Occasionally above flood stage due to manipulations of dams Nos. 22 and 24.
[3] Secondary crest occurred on the 11th.
[4] Continued into following month.
[5] Crest somewhat higher; water too high to read gage.

CLIMATOLOGICAL DATA

CONDENSED CLIMATOLOGICAL SUMMARY OF TEMPERATURE AND PRECIPITATION BY SECTIONS

[For description of tables and charts, see REVIEW, January, p. 31]

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

Section	Temperature								Precipitation					
	Section average	Departure from the normal	Monthly extremes						Section average	Departure from the normal	Greatest monthly		Least monthly	
			Station	Highest	Date	Station	Lowest	Date			Station	Amount	Station	Amount
	°F.	°F.		°F.			°F.		In.	In.		In.		In.
Alabama	78.2	+2.5	Wetumpka	101	8	Huntsville	43	27	2.76	−0.76	Citronelle	11.94	Florence	0.17
Arizona	69.8	−3.0	Mohawk	109	5	Alpine	21	25	2.13	+.80	Stephens Ranch	4.64	2 stations	.00
Arkansas	75.4	+.9	DeQueen	102	5	Gravette	39	26	3.57	+.26	Mount Ida CCC	8.71	Wilson	.07
California	65.2	−2.4	Cow Creek	113	6	Boca	17	28	.15	−.31	Crescent City (near)	2.55	119 stations	.00
Colorado	56.9	−1.2	Lamar	99	3	Leadville	9	9	2.97	+1.57	Rico	7.76	Walden	.52
Florida	80.5	+1.1	Camp Blanding	101	5	Quincy	56	20	6.22	−.44	Carrabelle	18.52	Daytona Beach	1.60
Georgia	77.3	+1.8	Milledgeville	104	9	Blairsville	42	[1] 22	1.96	−1.61	Brunswick	6.86	Resaca	.10
Idaho	52.7	−4.3	4 stations	91	[1] 12	Pelton's Ranch	10	28	1.63	+.54	Clark Fork	6.84	Hill City	.02
Illinois	70.4	+2.4	3 stations	98	[1] 2	Kewanee	34	26	4.96	+1.30	Rockford	10.26	Eddyville	.78
Indiana	70.6	+3.3	Scottsburg	98	9	Forest Reserve	32	27	2.22	−1.08	La Porte	7.54	Waterloo	.48
Iowa	66.6	+2.6	2 stations	95	4	Decorah	26	29	7.73	+3.91	Creston	14.26	Inwood (near)	2.49
Kansas	71.0	+1.2	Johnson	103	7	2 stations	32	9	4.76	+1.96	Moran	16.79	Hugoton	1.37
Kentucky	73.1	+2.5	Russellville	99	1	Beaver Dam	34	27	1.16	−1.72	Hazard	2.90	Earlington	T
Louisiana	79.7	+1.7	Lake Providence	99	[1] 6	Tallulah	49	27	5.80	+1.91	Lake Arthur (near)	13.47	Bastrop	1.47
Maryland-Delaware	70.0	+2.3	Dundalk, Md	100	1	Oakland, Md	31	[1] 13	.53	−2.79	Williamsport, Md	2.68	7 stations	T
Michigan	62.6	+2.9	5 stations	93	[1] 9	2 stations	23	29	4.52	+1.21	Mancelona	8.49	Pontiac	.43
Minnesota	60.0	+.8	3 stations	94	20	Zumbrota	22	29	4.76	+1.92	Hallock	11.91	Madison	1.34
Mississippi	78.2	+2.2	Clarksdale	100	19	Rochdale	41	27	2.82	−.20	Lucedale	7.39	Corinth	.54
Missouri	71.6	+2.2	3 stations	97	[1] 2	3 stations	35	26	5.83	+1.82	Fort Leonard Wood	11.33	Deering	.33
Montana	51.1	−4.1	2 stations	95	18	Busby	11	28	2.98	+1.00	Campbell Farm Camp No. 4.	6.85	Forks (near)	.64
Nebraska	65.2	+.7	Ogallala	102	3	Harrison	24	28	4.06	+2.00	Fairbury	12.63	Box Butte Experimental Farm.	1.03
Nevada	57.4	−3.9	Overton	106	6	Montello	13	8	.33	−.11	Tuscarora	1.79	9 stations	.00
New England	60.8	+.6	Brockton, Mass	96	16	Kearsarge, N. H	17	30	1.62	−2.17	Somerset, Vt	5.48	Baltic, Conn	.00
New Jersey	67.5	+1.7	2 stations	98	[1] 1	2 stations	26	30	.28	−3.51	Boonton	1.42	3 stations	.00
New Mexico	63.3	−1.1	do	100	[1] 5	4 stations	15	[1] 9	5.97	+4.20	White Tail	16.18	Red River Canyon	1.65
New York	63.2	+2.0	Bedford Hills	98	1	3 stations	21	30	2.13	−1.33	Big Moose	8.29	Mount Vernon	.07
North Carolina	73.2	+2.2	Salisbury	102	2	Banners Elk	33	22	1.56	−2.34	Mount Gilead	4.27	Natahala	.21
North Dakota	55.3	−1.6	5 stations	94	19	Portal	17	27	4.61	+3.05	Cavalier	9.34	Crosby	.75
Ohio	68.9	+3.2	Portsmouth	97	9	Newark	32	27	1.61	−1.32	Hillsboro	4.20	Prospect	.42
Oklahoma	74.8	+.5	Waukomis	103	7	Kenton	35	9	4.44	+1.33	Miami	14.77	Durant	1.13
Oregon	54.7	−3.0	Warm Springs Agency.	89	25	Fremont	16	28	1.83	+.61	2 stations	11.92	Owyhee Dam	.16
Pennsylvania	66.0	+1.8	2 stations	98	[1] 1	2 stations	24	[1] 28	1.33	−2.02	West Newton	4.10	Mount Pocono	.20
South Carolina	76.6	+2.2	Aiken	102	8	Cherokee (near)	45	21	1.49	−2.51	Winnsboro	4.45	Cherokee (near)	.12
South Dakota	61.7	.0	3 stations	98	19	Ardmore	21	28	2.87	+1.35	Danforth	6.08	Pine Ridge	.82
Tennessee	74.7	+3.2	Union City	100	19	Lynnville	36	27	.79	−2.17	Embreeville	3.48	McKenzie	.03
Texas	77.9	+.6	2 stations	106	[1] 1	3 stations	37	[1] 9	4.25	+1.36	Richmond	18.81	Temple	.25
Utah	56.9	−3.8	4 stations	96	[1] 5	Heber	16	28	1.12	+.06	Massey's Ranch	3.96	Callao	.04
Virginia	71.1	+2.5	Crozet	101	1	Big Meadows	31	14	1.36	−1.69	Stuart	4.41	Onley	.01
Washington	55.9	−2.4	Wahluke (near)	91	25	Bumping Lake	22	21	3.32	+1.57	Big Four	19.30	Sixprong	.34
West Virginia	67.8	+1.4	Ravenswood	99	10	Bayard	26	[1] 13	2.22	−.06	Summersville	5.97	Knobly Mountain	.35
Wisconsin	62.3	+1.9	2 stations	92	[1] 4	Meadow Valley	20	29	6.57	+2.87	Tomah	11.58	Menomonie	3.18
Wyoming	51.8	−3.0	Lagrange	94	11	2 stations	13	[1] 16	1.67	+.51	Knowles	5.86	Laramie	.35
Alaska (August)	56.3	+3.5	Eklutna (near)	80	20	Tanacross	22	31	1.43	−2.01	Chernofski	6.15	Moose Pass	.69
Hawaii	76.2	+1.8	Mana (Kauai)	95	23	Haleakala (Oui)	37	2	7.49	+1.77	Kukui (Maui)	58.00	Olowalu (Maui)	.00
Puerto Rico	78.8	+.5	Ponce	96	3	Guineo Reservoir	56	15	8.95	+.18	Cabo Rojo	22.52	Quebradillas	3.47

[1] Other dates also.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS

District and station	Elevation of instruments			Pressure			Temperature of the air												Precipitation			Wind								Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Barometer above sea level	Thermometer above ground	Anemometer above ground	Station, reduced to mean of 24 hours	Sea level, reduced to mean of 24 hours	Departure from normal	Mean max. + mean min. ÷ 2	Departure from normal	Maximum	Date	Mean maximum	Minimum	Date	Mean minimum	Greatest daily range	Mean wet thermometer	Mean temperature of the dew-point	Mean relative humidity	Total	Departure from normal	Days with 0.01 inch, or more	Average hourly velocity	Prevailing direction	Maximum velocity: Miles per hour	Maximum velocity: Direction	Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days			
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles								0-10	In.	In.
New England							61.5	+1.4										75	0.83	−2.3										4.0		
Eastport	75	67	85	29.94	30.02	−0.01	56.8	+1.0	82	22	65	36	30	49	30	51	48	80	1.26	−1.5	9	8.8	sw.	29	nw.	29	14	8	8	4.4	0.0	0.0
Greenville, Maine	1,070	6	41	28.86	30.12	......	54.9	+2.5	85	22	68	27	20	42	42	49	45	...	2.49	......	5	......	nw.	......	......	......	12	6	12	......	.0	.0
Portland, Maine [1]	103	5	36	29.93	30.04	−.01	58.8	−.8	90	16	73	23	30	45	43	52	47	72	1.42	−1.7	7	8.0	nw.	27	sw.	7	19	7	4	3.4	.0	.0
Concord [2]	289	54	72	29.75	30.06	.00	59.9	+.6	90	22	77	20	30	43	52	52	48	73	.91	−2.5	4	7.1	nw.	33	nw.	29	16	9	5	4.2	.0	.0
Burlington [2]	403	11	48	29.61	30.04	−.02	60.1	−.2	85	10	71	28	30	49	36	54	49	71	.93	−2.6	8	9.7	s.	31	s.	30	10	8	12	5.3	.0	.0
Northfield	876	12	60	29.13	30.08	+.02	57.4	+1.3	87	22	72	22	30	42	49	......	......	......	.81	−2.3	9	7.8	sw.	28	sw.	1	10	17	3	4.7	.0	.0
Boston [1]	124	33	62	29.93	30.06	−.01	66.0	+2.8	94	16	76	40	30	56	32	56	51	65	1.18	−2.0	3	10.8	sw.	29	nw.	29	12	13	5	4.4	.0	.0
Nantucket	12	10	63	30.07	30.08	.00	63.7	+.9	81	6	71	45	29	57	24	59	56	80	.49	−2.0	3	11.0	sw.	28	ne.	19	15	11	4	3.6	.0	.0
Block Island	26	11	46	30.06	30.09	+.01	64.2	+.8	82	23	71	48	29	58	24	59	56	79	.08	−2.6	3	13.9	sw.	34	nw.	29	20	9	1	2.4	.0	.0
Providence [1]	159	65	74	29.92	30.09	+.02	66.1	+2.9	92	16	78	37	30	54	34	57	53	74	1.03	−2.2	4	6.5	sw.	23	sw.	7	15	10	5	3.6	.0	.0
Hartford [1]	159	5	44	29.92	30.09	+.02	64.4	+2.7	92	16	78	32	30	51	39	57	53	75	.70	−2.8	2	8.0	sw.	28	n.	29	16	9	5	4.1	.0	.0
New Haven [2]	107	74	153	29.99	30.10	+.03	66.0	+2.5	92	1	76	40	30	56	35	58	55	77	.32	−3.2	2	8.6	s.	23	s.	30	14	14	2	3.8	.0	.0
Middle Atlantic States							70.1	+2.9										71	0.81	−2.3										3.9		
Albany [1]	97	26	40	29.97	30.08	+.01	63.2	+.1	91	10	77	31	30	49	45	55	51	74	1.60	−1.5	5	8.8	s.	30	nw.	28	15	12	3	3.7	.0	.0
Binghamton	871	57	79	29.19	30.12	+.05	64.4	+3.1	94	9	79	30	30	50	44	56	51	72	.52	−2.6	5	5.5	w.	18	w.	7	12	9	9	4.7	.0	.0
New York	314	415	454	29.76	30.09	+.01	69.0	+2.2	91	10	78	48	30	60	29	60	54	66	.11	−3.3	2	13.8	s.	49	nw.	29	16	10	4	3.6	.0	.0
Harrisburg	374	30	49	29.71	30.11	+.03	69.2	+3.4	96	10	82	44	30	56	40	59	54	66	.72	−2.3	3	6.8	w.	26	s.	10	14	10	6	4.1	.0	.0
Philadelphia [2]	114	174	367	29.99	30.12	+.04	71.3	+3.3	93	10	81	50	30	61	33	61	57	72	.51	−2.6	5	11.9	n.	39	s.	10	16	10	4	3.4	.0	.0
Reading	323	47	306	29.77	30.11	......	69.3	+2.7	93	10	81	43	30	57	40	59	53	64	.37	−2.8	4	9.8	nw.	33	nw.	29	19	7	4	3.3	.0	.0
Scranton	805	72	40	29.27	30.12	+.05	65.3	+2.4	92	1	78	34	30	52	38	......	......	......	1.00	−2.2	4	6.3	n.	35	nw.	29	16	12	2	3.5	.0	.0
Atlantic City	52	37	172	30.05	30.11	+.04	69.1	+2.3	94	1	76	50	30	62	25	62	59	75	.01	−2.6	1	14.7	s.	30	ne.	19	15	12	3	4.0	.0	.0
Trenton	190	89	107	29.91	30.11	......	68.6	+1.7	93	10	80	44	30	57	36	60	55	69	.19	−3.2	3	8.0	s.	24	w.	7	13	10	7	4.2	.0	.0
Baltimore [2]	123	100	215	29.99	30.12	+.04	73.2	+4.7	97	10	83	50	30	63	31	63	58	68	.50	−2.9	2	9.9	s.	32	sw.	5	16	10	4	3.6	.0	.0
Washington [2]	112	62	85	30.00	30.12	+.04	72.8	+4.7	96	10	83	49	30	62	35	63	59	69	.53	−2.7	5	5.7	sw.	25	nw.	5	17	8	5	3.6	.0	.0
Cape Henry	18	8	54	30.08	30.10	......	74.6	+2.8	96	1	80	64	28	69	26	68	65	78	.99	−1.9	4	12.3	ne.	33	n.	11	14	11	5	4.0	.0	.0
Lynchburg	686	144	184	29.40	30.14	+.06	72.8	+3.8	97	9	85	45	13	61	37	63	58	68	.09	−3.2	2	6.0	w.	19	ne.	18	15	10	5	4.1	.0	.0
Norfolk [2]	91	80	125	30.02	30.12	+.06	75.0	+3.4	94	1	82	61	13	68	24	67	65	81	2.80	−.4	5	9.5	ne.	24	e.	19	15	7	8	4.7	.0	.0
Richmond [2]	144	11	52	29.96	30.12	+.05	73.6	+3.1	97	1	84	49	13	63	35	64	61	78	2.20	−1.0	5	7.2	sw.	19	e.	19	15	10	5	3.5	.0	.0
South Atlantic States							76.9	+3.5										79	1.85	−2.4										4.3		
Asheville	2,253	89	104	27.82	30.12	+.05	70.4	+5.4	93	8	83	47	22	58	36	61	58	75	.28	−2.8	5	6.2	s.	26	ne.	8	16	12	2	3.4	.0	.0
Charlotte [2]	779	63	86	29.28	30.10	+.03	76.1	+4.6	98	8	87	52	13	65	36	66	63	76	1.18	−1.8	6	6.2	ne.	19	w.	25	14	9	7	4.3	.0	.0
Greensboro [1]	886	6	56	29.20	30.13	......	72.8	......	95	2	86	47	13	60	40	64	61	79	1.54	......	6	7.0	ne.	31	nw.	26	16	8	6	4.2	.0	.0
Hatteras	11	5	50	30.08	30.09	+.03	76.6	+2.1	89	9	82	65	28	71	17	72	70	86	1.07	−3.5	5	12.2	ne.	34	n.	22	15	9	6	4.4	.0	.0
Raleigh [1]	376	27	69	29.71	30.11	+.04	75.1	+4.0	99	8	88	50	13	63	37	66	63	76	1.53	......	3	7.9	ne.	32	sw.	3	14	9	7	4.4	.0	.0
Wilmington	72	73	107	30.03	30.10	+.05	77.1	+4.0	94	7	86	58	13	68	29	70	67	81	1.07	−3.4	6	8.5	ne.	21	w.	25	13	12	5	4.2	.0	.0
Charleston [2]	48	11	92	30.03	30.08	+.04	78.4	+1.8	96	5	85	64	20	72	19	70	68	87	.78	−3.8	7	10.7	ne.	31	ne.	20	9	11	10	5.4	.0	.0
Columbia, S. C. [2]	347	70	91	29.73	30.09	+.04	77.6	+3.1	97	7	88	54	23	67	37	69	66	79	1.27	−2.2	5	8.2	s.	22	sw.	25	21	6	3	3.3	.0	.0
Greenville, S. C.	1,040	70	78	29.03	30.11	......	75.9	+5.3	98	8	87	55	13	65	35	......	......	......	1.38	−2.3	5	5.7	ne.	20	sw.	25	21	5	4	3.3	.0	.0
Augusta [2]	182	62	77	29.89	30.08	+.03	79.0	+3.7	98	8	90	55	23	68	37	68	64	71	.86	−2.5	3	5.8	ne.	19	nw.	26	15	10	5	4.0	.0	.0
Savannah [2]	65	73	152	30.01	30.07	+.04	80.0	+3.8	97	6	89	62	23	71	28	71	69	84	1.26	−4.2	6	9.4	ne.	30	se.	14	14	7	9	4.4	.0	.0
Jacksonville [2]	43	86	110	30.00	30.05	+.05	79.5	+1.2	95	6	86	68	20	72	20	73	72	86	9.35	+2.0	15	7.1	e.	26	ne.	20	8	12	10	5.8	.0	.0
Florida Peninsula							82.5	+1.4										85	6.12	−1.6										6.8		
Key West [2]	21	10	64	29.94	29.96	+.02	83.1	+.9	92	1	89	73	18	78	17	77	76	81	4.93	−1.8	16	9.3	e.	30	sw.	18	4	10	16	6.9	.0	.0
Miami [2]	25	124	168	29.95	29.97	.00	81.9	+1.8	91	1	87	72	20	77	17	76	74	85	7.03	−1.3	18	8.6	e.	26	e.	30	5	10	15	6.9	.0	.0
Tampa [1]	35	5	61	29.96	30.00	+.03	82.0	......	96	5	89	71	22	75	20	75	74	88	6.40	.0	15	9.8	e.	33	se.	16	4	11	15	6.7	.0	.0
East Gulf States							79.3	+3.0										80	4.11	−0.2										4.9		
Atlanta [1]	1,173	5	72	28.87	30.07	+.02	76.6	......	99	8	88	55	23	66	34	66	63	72	1.35	......	5	7.7	ne.	25	e.	13	15	8	7	3.6	.0	.0
Macon [2]	370	79	87	29.68	30.07	+.04	77.8	+3.0	97	8	88	52	23	67	38	68	64	72	2.06	−1.1	4	6.5	s.	21	s.	25	14	7	9	4.9	.0	.0
Thomasville	273	49	58	29.78	30.06	+.05	78.0	+1.2	95	8	87	62	20	69	26	......	......	......	4.42	......	12	......	e.	......	......	......	5	11	14	......	.0	.0
Apalachicola	35	11	51	29.98	30.01	......	79.7	+1.2	92	7	85	68	20	74	16	75	73	84	8.87	+.8	14	10.1	e.	36	e.	17	11	9	10	5.6	.0	.0
Pensacola	56	54	79	29.95	30.01	+.02	80.4	+2.4	93	7	87	69	20	74	18	74	72	82	4.46	−.9	10	8.6	e.	30	se.	17	10	10	10	5.7	.0	.0
Anniston	741	9	......	......	......	......	76.6	+5.3	96	8	88	52	27	65	35	......	......	......	.64	......	3	......	se.	......	......	......	14	14	2	......	.0	.0
Birmingham [2]	700	11	48	29.33	30.06	+.03	78.8	+4.0	95	8	89	56	27	68	31	68	65	77	1.77	−1.6	7	6.2	e.	21	se.	24	16	12	2	3.7	.0	.0
Mobile [2]	57	86	161	29.95	30.01	+.01	80.7	+2.6	96	6	88	68	20	73	22	73	72	84	5.21	+.2	11	6.8	ne.	20	e.	13	11	8	11	5.2	.0	.0
Montgomery [2]	218	92	105	29.82	30.05	+.03	79.9	+3.6	97	8	89	63	27	71	25	70	67	77	4.35	+1.4	9	6.6	e.	21	e.	13	14	7	9	4.6	.0	.0
Meridian [2]	375	67	92	29.64	30.03	+.01	78.9	+4.4	95	6	89	57	27	69	31	71	69	83	3.46	+.5	6	5.8	e.	23	s.	24	12	13	5	4.8	.0	.0
Vicksburg [2]	247	82	102	29.74	30.00	−.02	79.2	+2.9	95	29	88	58	26	71	27	70	68	86	1.48	−1.4	6	8.4	e.	27	sw.	3	12	9	9	4.9	.0	.0
New Orleans [2]	53	76	84	29.92	29.98	.00	82.0	+2.8	94	6	88	72	26	76	16	74	73	84	5.30	+.3	15	8.2	se.	24	e.	22	9	8	13	5.8	.0	.0
West Gulf States							79.1	+2.2										79	4.95	+1.3										5.8		
Shreveport [2]	249	92	227	29.71	29.97	−.03	79.6	+2.7	95	6	89	57	26	71	30	72	70	81	2.77	.0	9	10.2	ne.	40	se.	24	10	10	10	5.1	.0	.0
Bentonville	1,303	12	51	28.65	30.00	−.02	71.4	+2.5	91	3	82	42	26	61	33	......	......	......	4.97	+1.3	9	6.8	s.	19	w.	22	7	15	8	4.2	.0	.0
Fort Smith	463	57	82	......	29.96	−.05	76.8	+2.8	96	1	86	50	26	67	......	......	......	70	3.30	+.3	5	7.3	e.	......	......	......	11	10	9	......	.0	.0
Little Rock [2]	357	94	102	29.63	30.01	−.02	76.1	+2.0	91	1	84	53	26	68	27	68	66	81	2.40	−.8	4	7.6	e.	34	w.	24	10	12	8	4.9	.0	.0
Austin [2]	605	68	90	29.29	29.91	......	80.8	+2.5	97	4	90	62	26	71	27	72	69	76	.77	−2.6	5	7.5	e.	29	e.	22	4	20	6	5.5	.0	.0
Brownsville [2]	57	88	96	29.80	29.86	......	82.8	+2.2	95	1	90	73	23	76	19	76	74	83	4.41	−1.1	9	9.2	se.	24	se.	8	5	16	9	6.1	.0	.0
Corpus Christi [2]	20	11	78	29.86	29.88	−.07	83.6	+3.9	94	2	90	72	24	78	20	76	75	86	.90	−3.6	9	11.5	s.	24	s.	2	11	9	10	5.3	.0	.0
Dallas [1]	512	6	46	29.41	29.94	......	79.9	......	98	4	90	55	26	70	32	70	66	69	1.22	−1.5	3	10.6	se.	34	se.	8	14	8	8	4.5	.0	.0
Fort Worth [1]	679	35	56	29.24	29.94	−.05	79.8	......	99	3	91	55	26	68	34	70	67	71	1.28	−1.2	5	11.0	se.	43	nw.	24	10	12	8	4.9	.0	.0
Galveston [2]	54	106	114	29.84	29.90	−.08	80.7	+.6	89	4	85	72	23	77	13	76	74	84	15.32	+9.8	16	11.5	s.	53	s.	23	9	9	12	5.9	.0	.0
Houston [2]	138	157	190	29.77	29.92	......	80.4	+1.4	93	4	88	66	26	73	21	74	73	88	6.91	+2.8	13	10.4	se.	60	e.	23	6	11	13	6.5	.0	.0
Palestine	510	64	72	29.43	29.95	−.04	78.6	+1.6	96	4	88	57	26	70	26	71	68	79	4.84	+1.9	9	7.4	e.	34	nw.	24	10	13	7	5.0	.0	.0
Port Arthur	34	50	134	29.89	29.93	......	80.8	......	92	8	86	67	26	75	16	74	73	82	15.37	+10.6	12	14.7	ne.	57	se.	23	8	13	9	5.6	.0	.0
San Antonio [1]	693	28	59	29.19	29.90	−.06	81.6	......	98	2	91	66	26	72	24	73	70	76	4.88	+1.8	6	8.9	se.	27	n.	9	1	21	8	6.3	.0	.0

See footnotes at end of table.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS—Continued

District and station	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew-point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01 inch, or more	Wind: Average hourly velocity	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles								0-10	In.	In.
Ohio Valley and Tennessee							72.0	+3.9										73	1.79	−1.2										3.8		
Chattanooga [1]	762	21	54	29.27	30.08	+0.02	74.4	......	95	8	89	45	27	60	41	65	62	78	.34	......	5	4.6	ne.	25	se.	24	14	14	2	3.5	0.0	0.0
Knoxville [3]	995	66	84	29.05	30.09	+.03	75.8	+5.2	96	2	88	53	27	63	35	64	59	70	.97	−1.7	5	4.9	ne.	21	sw.	2	19	10	1	2.4	.0	.0
Memphis [3]	399	78	86	29.60	30.02	−.01	76.9	+3.3	95	19	88	46	27	66	38	67	64	73	.46	−2.3	5	6.9	e.	33	sw.	24	13	12	5	3.9	.0	.0
Nashville [1]	546	5	72	29.48	30.06	.00	76.2	......	96	8	89	44	27	63	41	65	60	67	.62	−2.8	3	7.3	s.	35	sw.	25	16	10	4	3.8	.0	.0
Lexington	989	6	......	29.06	30.12	+.05	73.6	+5.1	96	2	88	45	27	59	41	......	......	......	.67	......	8	......	sw.	......	......	......	19	10	1	2.8	.0	.0
Louisville [3]	525	106	120	29.51	30.07	+.01	74.2	+3.7	95	9	86	48	27	63	34	62	57	67	.64	−2.1	5	8.4	sw.	45	sw.	25	19	11	0	2.5	.0	.0
Evansville [1]	431	5	38	29.60	30.05	−.01	72.4	......	93	9	86	38	27	59	45	62	57	69	.71	−2.6	8	8.1	sw.	42	sw.	25	12	9	9	4.3	.0	.0
Indianapolis [3]	823	98	129	29.18	30.06	.00	71.8	+4.9	91	9	83	46	26	61	30	61	57	74	1.94	−1.5	9	7.8	sw.	33	sw.	25	14	4	12	5.0	.0	.0
Terra Haute [3]	575	68	149	29.45	30.06	......	71.6	......	92	8	83	44	26	60	33	62	60	79	7.32	+3.7	9	9.0	s.	33	sw.	25	12	9	9	4.5	.0	.0
Cincinnati [2]	627	11	51	29.41	30.08	+.01	71.8	+4.7	93	9	84	45	27	60	38	62	58	74	1.88	−.8	6	6.5	ne.	31	sw.	25	15	7	8	4.2	.0	.0
Columbus [2]	822	90	110	29.22	30.08	+.01	70.6	+4.1	92	9	82	45	29	59	34	60	56	71	1.82	−.8	5	9.1	s.	46	sw.	25	14	10	6	4.2	.0	.0
Dayton	900	186	213	29.14	30.09	......	70.2	+3.6	91	9	81	44	29	59	32	60	56	71	1.74	−1.2	7	9.6	sw.	53	sw.	25	15	7	8	4.3	.0	.0
Elkins [3]	1,947	61	78	28.12	30.16	+.08	65.2	+2.2	91	9	79	36	13	52	41	57	55	88	1.85	−1.3	9	4.6	ne.	37	w.	5	12	10	8	4.4	.0	.0
Parkersburg	637	77	84	29.43	30.10	+.02	69.9	+2.6	95	9	82	42	27	57	37	61	58	75	2.36	−.4	6	4.7	se.	27	sw.	5	15	10	5	3.7	.0	.0
Pittsburgh [1]	1,273	39	54	29.22	30.12	+.04	67.5	......	92	9	79	45	27	56	34	58	54	71	1.00	−1.6	7	9.3	s.	33	sw.	25	16	9	5	4.0	.0	.0
Lower Lake Region							65.6	+3.0										72	1.39	−1.6										4.4		
Buffalo [2]	768	243	280	29.26	30.08	+.02	65.1	+2.7	84	3	73	40	29	57	32	56	52	70	.87	−2.0	6	15.1	sw.	65	sw.	25	14	10	6	3.9	.0	.0
Canton	448	10	61	29.57	30.04	......	60.2	+.9	85	5	73	32	13	48	40	54	49	70	1.55	−1.8	6	8.7	sw.	40	sw.	25	11	11	8	5.1	.0	.0
Ithaca	836	77	100	......	......	......	64.3	+2.7	94	9	78	31	30	51	42	......	......	......	1.03	−2.0	5	8.7	nw.	32	s.	25	14	10	6	4.3	.0	.0
Oswego	335	71	85	29.70	30.07	+.01	64.0	+2.8	91	9	73	35	30	55	35	57	53	72	1.41	−1.3	7	9.4	s.	26	nw.	28	12	13	5	4.2	.0	.0
Rochester [1]	523	5	69	29.51	30.08	+.02	64.1	......	92	9	77	36	29	51	41	56	53	76	2.09	−.4	8	9.5	sw.	44	w.	25	13	9	8	4.5	.0	.0
Syracuse [1]	596	5	51	29.44	30.07	.00	63.6	......	94	9	77	32	30	50	42	56	52	73	2.28	−.4	9	9.6	sw.	34	s.	25	9	15	6	5.1	.0	.0
Erie [2]	714	57	81	29.33	30.10	+.04	67.3	+3.7	91	9	76	41	30	58	34	58	55	78	1.52	−1.9	7	8.2	s.	34	sw.	25	13	11	6	4.0	.0	.0
Cleveland [1]	762	27	54	29.27	30.09	+.03	67.8	......	92	9	80	44	29	56	39	58	54	67	1.49	−1.8	9	10.8	s.	44	s.	25	13	8	9	4.6	.0	.0
Sandusky	629	5	67	......	......	......	69.2	+3.9	95	9	80	45	27	58	36	......	......	......	1.10	−1.9	7	8.9	sw.	38	sw.	25	16	7	7	3.9	.0	.0
Toledo [3]	628	79	87	29.40	30.08	+.02	68.8	+4.4	91	9	79	42	29	59	33	58	55	73	1.77	−1.0	5	9.4	sw.	38	w.	25	18	6	6	3.5	.0	.0
Fort Wayne [1]	857	69	84	29.15	30.06	......	68.6	......	92	9	82	40	27	56	38	59	55	71	.74	−2.3	6	8.6	s.	51	w.	25	10	12	8	4.7	.0	.0
Detroit [1]	730	5	78	29.30	30.08	+.02	67.6	......	91	16	78	41	29	57	30	58	54	69	.81	−2.1	7	10.3	sw.	46	sw.	25	13	10	7	4.6	.0	.0
Upper Lake Region							61.9	+2.7										79	5.33	+2.1										6.1		
Alpena	609	5	89	29.36	30.02	−.01	60.8	+3.2	88	22	70	35	29	52	32	55	53	80	4.02	+1.0	9	11.5	nw.	37	se.	30	8	9	13	6.1	.0	.0
Escanaba	612	51	72	......	29.98	−.03	59.2	+2.1	82	22	66	33	29	52	......	......	......	83	5.09	+1.8	11	10.9	s.	29	nw.	25	3	16	11	......	.0	.0
Grand Rapids [2]	707	70	244	29.25	30.01	−.04	67.0	+4.3	90	9	77	41	29	57	32	58	54	76	5.63	+2.1	9	11.4	s.	42	sw.	30	10	11	9	4.9	.0	.0
Lansing [2]	878	5	90	29.11	30.05	......	64.4	+3.0	89	9	75	36	29	54	31	57	53	73	2.96	.0	9	8.6	s.	34	nw.	25	12	12	6	4.8	.0	.0
Marquette	734	44	73	29.15	29.95	−.05	59.9	+2.4	88	21	68	37	29	52	25	54	52	80	3.66	+.4	12	10.1	s.	31	sw.	26	6	8	16	6.8	.0	.0
Sault Sainte Marie [3]	614	11	52	29.32	29.99	−.03	56.4	+.9	83	21	65	32	29	47	30	52	50	86	6.49	+3.0	14	11.7	e.	41	nw.	25	5	5	20	7.4	.0	.0
Chicago	673	7	131	29.31	30.03	−.01	68.8	+3.6	90	4	77	44	26	61	29	61	57	72	5.20	+2.1	11	10.3	sw.	29	nw.	25	13	8	9	4.8	.0	.0
Green Bay	617	109	141	29.32	29.99	−.03	63.4	+3.0	87	21	72	36	29	55	29	57	53	73	4.08	+.6	9	10.8	s.	32	se.	4	4	12	14	6.8	.0	.0
Milwaukee [1]	681	33	66	29.28	30.01	−.02	64.6	......	90	4	74	38	26	55	29	58	55	78	9.87	+6.6	10	12.6	sw.	52	sw.	4	9	9	12	5.6	.0	.0
Duluth	1,133	5	47	28.71	29.93	−.05	56.9	+1.8	82	20	64	34	29	49	28	52	50	86	6.28	+3.0	13	11.6	ne.	34	w.	16	3	9	18	7.4	T	.0
North Dakota							55.6	−1.3										75	4.60	+3.1										6.0		
Moorhead, Minn. [3]	940	50	58	28.86	29.87	−.09	58.3	+.1	90	20	68	32	29	49	35	52	50	79	3.57	+1.4	12	9.5	s.	32	ne.	13	8	11	11	5.8	T	.0
Bismarck [1]	1,677	4	41	28.10	29.88	−.06	57.2	......	94	19	68	29	28	46	40	50	46	72	3.91	+2.7	9	11.6	se.	45	w.	30	8	10	12	6.0	1.0	.0
Devils Lake	1,478	11	44	28.31	29.88	−.06	54.6	−1.3	90	19	64	28	28	45	33	50	47	79	8.34	+6.7	14	9.7	nw.	26	nw.	5	7	4	19	7.0	.0	.0
Lemmon, S. Dak	2,602	4	38	27.17	29.87	......	56.2	......	92	19	68	26	28	45	39	49	44	......	4.32	......	15	......	se.	......	......	......	6	9	15	......	......	......
Grand Forks	832	11	71	28.97	29.87	......	56.0	......	91	19	66	30	25	46	37	51	49	......	4.72	......	13	......	s.	......	......	......	6	8	16	......	T	.0
Williston	1,878	42	50	27.90	29.88	−.05	54.0	−2.6	88	18	64	27	27	44	38	45	41	70	2.57	+1.5	11	7.6	n.	29	e.	3	11	9	10	5.2	.0	.0
Upper Mississippi Valley							68.8	+3.2										75	5.97	+2.3										5.3		
Minneapolis-St. Paul, Minn [1]	919	32	61	28.94	29.92	−.07	63.2	......	88	20	73	36	29	53	31	56	52	73	3.47	+.3	14	11.7	s.	38	w.	4	4	10	16	6.6	.0	.0
Springfield, Minn	1,025	4	42	28.82	29.91	......	63.1	......	92	20	74	33	28	52	37	56	52	......	2.45	......	10	......	s.	......	......	......	8	9	13	......	.0	.0
La Crosse [3]	714	11	48	29.19	29.95	−.06	64.2	+2.0	88	4	74	36	29	55	26	58	54	78	7.34	+3.4	14	5.4	s.	16	w.	5	6	9	15	6.6	.0	.0
Madison [3]	974	70	78	28.97	30.01	−.02	65.2	+2.8	89	4	74	41	29	56	25	58	55	79	10.34	+6.6	11	8.4	s.	26	s.	4	11	5	14	5.8	.0	.0
Charles City	1,015	10	51	28.89	29.98	−.02	64.0	+3.0	89	4	75	33	29	53	31	57	54	75	6.23	+2.6	12	7.3	se.	25	sw.	14	10	11	9	5.3	.0	.0
Davenport [3]	606	66	161	29.35	30.01	−.02	69.2	+3.6	92	4	79	42	26	59	27	60	57	78	5.19	+1.6	14	9.7	sw.	38	ne.	7	12	5	13	5.2	.0	.0
Des Moines [3]	860	5	99	29.03	29.95	−.07	67.2	+1.6	88	20	77	38	29	57	29	60	56	74	8.36	+4.7	14	9.7	se.	34	se.	6	15	3	12	4.8	.0	.0
Dubuque	699	60	79	29.24	29.99	−.04	66.8	+2.8	92	4	77	39	29	57	28	59	56	75	8.94	+4.9	14	5.9	s.	21	ne.	7	10	8	12	5.7	.0	.0
Keokuk	614	64	78	29.35	30.00	−.03	70.8	+3.3	92	4	80	44	26	61	28	......	......	......	4.73	+.9	12	7.7	sw.	26	w.	8	12	6	12	4.9	.0	.0
Cairo	358	87	93	29.66	30.04	−.01	75.2	+3.7	93	1	85	52	26	65	29	......	......	......	1.58	−1.3	7	7.7	s.	29	se.	24	10	15	5	4.6	.0	.0
Peoria [3]	609	11	45	29.36	30.02	−.02	69.7	+5.4	93	4	81	38	26	58	33	61	58	77	4.87	+.8	11	5.1	s.	17	w.	8	12	10	8	4.5	.0	.0
Springfield, Ill. [3]	636	5	191	29.35	30.03	−.02	71.4	+3.8	93	8	82	44	26	61	34	61	58	77	6.97	+3.3	11	11.0	s.	32	s.	25	11	3	16	5.4	.0	.0
St. Louis [3]	568	179	303	29.42	30.02	−.02	73.4	+2.9	93	7	82	47	29	64	27	63	59	66	3.58	+.1	10	11.6	sw.	38	sw.	9	14	6	10	4.4	.0	.0
Missouri Valley							69.0	+2.0										75	4.89	+1.6										5.2		
Columbia, Mo. [2]	784	6	66	29.17	30.00	−.03	71.6	+3.4	91	3	82	42	26	62	30	64	61	78	6.35	+2.0	13	6.9	s.	21	nw.	25	14	9	7	4.2	.0	.0
Kansas City [1]	963	38	76	......	29.96	−.06	72.4	......	92	3	82	42	26	63	......	......	......	......	4.62	+.1	10	11.1	se.	34	sw.	27	9	8	13	......	.0	.0
St. Joseph [2]	967	11	49	28.94	29.96	......	70.6	......	92	3	80	43	28	61	32	63	61	80	5.40	+1.5	14	9.0	s.	21	nw.	29	11	8	11	5.3	.0	.0
Springfield, Mo. [1]	1,324	5	60	28.63	30.01	−.02	70.2	+1.3	91	3	80	40	26	60	29	64	61	81	7.64	+4.1	12	10.8	se.	36	sw.	4	9	10	11	5.6	.0	.0
Topeka	987	65	87	28.91	29.95	......	71.3	+2.6	93	5	81	42	28	62	31	63	60	73	3.81	.0	9	9.5	s.	30	sw.	27	10	10	10	5.4	.0	.0
Lincoln [2]	1,189	11	81	28.67	29.91	−.08	69.2	+2.8	93	3	80	37	28	58	36	60	56	74	5.12	+2.1	10	10.8	s.	37	s.	14	11	8	11	5.3	.0	.0
Omaha [1]	1,105	31	44	28.77	29.93	−.07	68.6	......	91	1	80	38	28	58	37	61	57	74	5.27	+2.1	12	12.8	se.	36	se.	14	12	7	11	......	.0	.0
Valentine	2,598	46	54	27.21	29.89	−.07	62.5	.0	94	19	75	33	28	50	38	54	48	67	3.02	+1.7	11	10.3	s.	33	w.	3	12	8	10	5.1	T	.0
Sioux City [1]	1,138	5	27	28.71	29.92	−.06	65.2	......	89	20	76	34	28	54	36	58	54	74	7.49	......	11	10.8	se.	29	s.	20	12	6	12	5.4	.0	.0
Huron [1]	1,306	26	41	28.50	29.88	−.08	63.6	......	95	20	75	31	28	52	40	56	50	70	2.79	+1.2	16	15.4	s.	49	s.	3	9	9	12	5.6	.0	.0
Northern Slope							54.9	−2.8										66	2.27	+1.1										6.5		
Billings [1]	3,570	18	39	26.25	29.90	......	54.0	......	85	18	65	29	27	43	34	46	40	67	4.99	......	12	10.3	sw.	41	nw.	7	4	10	16	7.1	6.0	.0
Havre	2,507	11	67	27.28	29.90	−.04	52.7	−3.7	80	1	64	30	27	41	41	45	39	66	3.53	+2.2	11	8.1	sw.	27	sw.	12	6	9	15	6.6	T	.0
Helena [1]	4,124	5	35	25.76	29.95	−.02	50.4	−6.2	81	17	62	29	22	39	45	44	38	66	2.27	+1.0	15	8.6	w.	33	n.	26	2	11	17	7.5	1.9	.0
Missoula [2]	3,263	80	91	26.60	29.97	......	52.4	−3.0	76	17	62	31	28	43	35	46	42	74	1.62	+.2	16	5.7	se.	27	w.	26	4	7	19	7.7	.0	.0
Kalispell	2,973	48	56	26.88	29.93	−.03	50.5	−3.0	71	5	59	32	21	42	34	45	41	75	2.00	+.8	15	5.1	w.	21	nw.	26	3	4	23	8.1	T	.0
Miles City [2]	2,371	48	55	27.41	29.89	−.06	56.8	−4.4	93	18	67	30	28	46	42	48	43	71	4.01	+3.0	11	6.1	s.	29	ne.	7	7	6	17	6.8	2.7	.0
Rapid City [3]	3,259	50	58	26.54	29.87	−.09	58.8	−1.6	91	19	71	27	28	47	43	49	41	62	1.09	−.1	12	7.2	n.	26	nw.	15	11	11	8	5.3	T	.0
Cheyenne [1]	6,094	5	39	23.99	29.88	−.08	54.6	......	83	3	69	27	9	40	41	44	35	55	1.10	−.1	9	10.6	nw.	42	nw.	3	8	13	9	5.7	2.0	.0
Lander	5,352	60	68	24.62	29.89	−.07	52.6	−3.1	82	11	67	26	28	38	41	43	34	58	1.74	+.8	10	5.5	sw.	27	n.	30	9	12	9	5.6	1.0	.0
Sheridan [6]	3,790	6	42	26.04	29.90	......	54.0	......	88	11	66	29	28	41	43	45	39	66	2.04	+.8	16	9.2	nw.	53	nw.	7	5	8	17	6.8	3.2	.0
North Platte [3]	2,821	11	51	26.99	29.87	−.10	64.8	+2.7	94	3	78	33	28	52	40	55	50	68	3.31	+2.0	7	8.6	s.	24	nw.	1	12	12	6	4.6	.0	.0

See footnotes at end of table.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS—Continued

District and station	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max.+mean min.÷2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew-point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01 inch, or more	Wind: Average hourly velocity	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles								0–10	In.	In.
Middle Slope							72.1	+1.8										64	3.11	+1.0										4.9		
Denver ¹	5,292	106	113	24.70	29.86	−0.10	61.7	......	89	3	74	35	9	50	37	48	39	53	2.04	+1.0	8	7.5	s.	31	ne.	7	11	13	6	4.7	T	0.0
Pueblo	4,670	5	36	25.24	29.85	−.11	63.2	......	93	3	79	33	9	48	46	50	42	56	1.72	+1.0	6	7.9	e.	37	n.	7	15	9	6	4.1	.0	.0
Concordia	1,392	50	58	28.47	29.91	−.08	70.3	+2.0	94	7	80	40	28	60	39	62	58	68	4.45	+1.8	9	9.6	s.	24	sw.	20	9	12	9	5.0	.0	.0
Dodge City	2,509	10	86	27.34	29.88	−.10	70.8	+1.4	99	6	83	40	28	59	46	59	53	61	1.58	−.3	4	14.1	s.	33	s.	20	10	13	7	4.7	.0	.0
Wichita ¹	1,358	6	64	28.53	29.94	−.06	72.2	+1.6	98	3	83	42	28	61	34	63	60	73	4.29	+1.2	9	16.7	s.	42	se.	1	12	7	11	5.5	.0	.0
Oklahoma City ²	1,214	10	47	28.69	29.95	−.04	75.2	+2.4	98	3	85	46	29	65	32	66	62	72	4.57	+1.5	8	9.4	s.	23	sw.	4	12	11	7	5.4	.0	.0
Southern Slope							74.2	+0.6										72	4.82	+2.3										5.6		
Abilene ²	1,738	10	56	28.14	29.91	−.05	76.9	+1.6	97	2	87	52	29	66	35	67	64	76	2.30	−.4	7	9.4	s.	27	se.	8	13	11	6	4.8	.0	.0
Amarillo ²	3,676	10	49	26.26	29.90	−.06	69.2	−.1	95	5	81	40	29	57	35	60	55	69	4.30	+2.0	6	15.7	s.	42	sw.	3	8	11	11	5.5	.0	.0
Del Rio	960	63	71	28.89	29.85	−.09	80.8	+1.6	99	2	89	67	26	73	24	71	66	68	4.90	+1.9	7	9.4	se.	22	n.	16	6	13	11	6.1	.0	.0
Roswell	3,566	75	85	26.34	29.89	−.03	69.7	−.6	92	5	81	46	29	58	35	61	58	74	7.80	+5.7	15	7.8	s.	40	nw.	8	10	7	13	5.9	.0	.0
Southern Plateau							75.4	−1.6										49	1.52	+0.8										3.0		
El Paso ²	3,778	82	101	26.13	29.81	−.07	74.4	+.5	94	2	84	53	25	64	29	62	56	61	4.19	+2.9	10	7.9	e.	32	se.	27	10	10	10	5.4	.0	.0
Albuquerque ¹	5,314	5	45	24.73	29.83	......	67.3	......	89	3	80	45	24	55	34	54	44	51	1.85	+1.0	9	8.4	se.	39	nw.	27	14	9	7	4.2	.0	.0
Flagstaff	6,907	10	59																													
Phoeniz ²	1,107	39	87	28.61	29.74	−.07	80.6	−2.1	104	17	96	55	24	66	39	62	49	43	1.79	+1.0	5	5.2	e.	30	se.	12	24	6	0	2.0	.0	.0
Tucson ¹	2,555	5	23	27.22	29.75	......	79.4	......	100	2	93	48	23	66	39	61	51	45	1.20	.0	6	......	se.				17	11	2	2.8	.0	.0
Yuma	142	9	54	29.60	29.74	−.04	80.8	−2.9	106	11	98	55	22	64	42	63	50	43	.08	−.3	1	4.6	sw.	17	w.	21	28	2	0	.6	.0	.0
Independence	3,957	5	26	25.88	29.85	−.01	66.0	−2.0	94	6	83	39	23	49	40	48	31		.00	−.1	0		se.				30				.0	.0
Middle Plateau							58.8	−3.3										47	0.80	+0.1										3.3		
Reno	4,527	61	76	25.43	29.93	−.02	58.0	−2.5	89	5	73	34	28	43	42	44	32	49	T	−.3	0	5.5	w.	24	sw.	11	24	5	1	1.9	.0	.0
Tonopah	6,090	12	20	24.02	29.87		58.8		85	6	71	34	20	47	30	42	25		.00		0		nw.				22	6	2		.0	.0
Winnemucca	4,339	5	56	25.59	29.92	−.01	55.4	−3.8	88	5	74	27	21	37	49	43	29	44	.12	−.3	2	7.1	ne.	32	w.	11	16	13	1	3.6	.0	.0
Modena	5,473	10	46				56.0	−4.0	86	5	73	31	9	39	46				.45	−.4	3	10.7	sw.	36	s.	11	19	9	2	2.6	T	.0
Salt Lake City ²	4,357	86	210	25.55	29.87	−.08	61.2	−3.2	88	11	74	38	28	49	35	47	35	46	.52	−.5	5	10.2	se.	38	s.	11	14	9	7	4.0	.0	.0
Grand Junction	4,602	60	68	25.33	29.87	−.08	63.4	−2.8	90	6	76	42	9	51	34	51	40	49	2.90	+2.0	7	6.9	se.	28	sw.	11	14	9	7	4.3	.0	.0
Northern Plateau							57.5	−2.8										59	0.97	+0.2										5.9		
Baker ²	3,471	36	54	26.42	29.98	−.01	52.0	−4.0	78	25	64	31	28	40	39	45	39	69	.67	−.1	8	5.5	s.	21	nw.	22	7	10	13	5.9	.0	.0
Boise ¹	2,739	5	49	27.11	29.92	−.05	57.9		86	10	71	32	22	45	41	48	40	55	.22		2	9.5	nw.	36	nw.	18	13	12	5	4.5	.0	.0
Pocatello ¹	4,478	5	31	25.42	29.90	−.06	55.0		83	10	68	29	28	42	45	44	33	49	.76	.0	5	10.6	sw.	40	w.	11	9	10	11	5.8	.0	.0
Spokane ¹	1,929	27	42	27.91	29.94	−.04	55.6		77	25	65	34	21	46	36	49	43	67	1.36	+.5	10	6.6	s.	29	nw.	26	4	12	14	7.1	.0	.0
Walla Walla	991	57	65	28.89	29.96	−.04	61.3	−2.5	82	25	70	42	22	52	29				1.67	+.7	11	6.0	s.	21	sw.	14	5	9	16	6.7	.0	.0
Yakima	1,076	58	67	28.80	29.95		59.3	−1.8	84	25	71	37	20	48	34	51	43	57	.41	−.1	5	5.5	nw.	24	w.	30	11	8	11	5.6	.0	.0
North Pacific Coast Region							58.8	+0.6										77	3.55	+1.4										6.5		
North Head	211	5	56	29.78	30.00	−.03	58.2	+1.7	66	2	62	48	19	54	15	56	54	85	5.77	+2.8	24	12.2	n.	41	s.	9	5	8	17	6.8	.0	.0
Seattle ²	125	90	321	29.85	29.99	−.02	58.9	+.8	74	24	65	45	21	53	23	54	51	80	3.03	+1.3	13	8.6	s.	34	s.	3	4	3	23	7.7	.0	.0
Tacoma	194	172	201	29.80	30.01	−.01	57.9	+.6	73	5	64	43	21	51	22				3.55	+1.5	15	8.0	sw.	27	sw.	3	4	5	21	7.7	.0	.0
Tatoosh Island	86	9	61	29.89	29.98	−.03	55.8	+2.8	67	7	60	46	27	52	14	54	52	88	5.43	+.8	21	10.7	e.	45	e.	9	6	7	17	7.0	.0	.0
Medford ¹	1,329	29	58	28.60	29.90		61.0		87	25	76	35	21	46	46	52	44	62	1.21	+.7	6		nw.				17	7	6	3.9	.0	.0
Portland, Oreg.²	154	68	106	29.84	30.01	−.02	61.4	−.3	78	24	69	47	28	54	25	56	52	79	3.58	+1.6	12	5.3	nw.	18	w.	10	4	10	16	7.1	.0	.0
Roseburg	510	45	76	29.47	30.02	.00	60.6	−2.3	84	9	73	38	21	48	38	54	49	70	2.28	+1.0	8	3.8	n.	18	sw.	19	11	8	11	5.2	.0	.0
Middle Pacific Coast Region							63.8	+1.7										60	0.14	−0.5										3.0		
Eureka	60	72	88	29.95	30.02	+.01	57.6	+1.7	70	1	63	46	21	52	20	54	52	84	.48	−.5	3	6.9	n.	35	n.	7	12	12	6	4.5	.0	.0
Redding ¹	722	20	34	29.11	29.88		72.0		99	5	84	48	19	60	31	54	37	32	.08	−.7	2	9.2	nw.	26	n.	7	19	7	4	3.0	.0	.0
Sacramento ⁵	66	92	115	29.79	29.86	−.03	70.2	+.9	98	6	84	48	20	56	36	56	45	49	T	−.4	0	7.5	s.	27	nw.	21	27	3	0	1.3	.0	.0
San Francisco	155	112	132	29.73	29.89	−.05	63.5	+2.6	87	5	70	55	23	57	28	57	52	74	T	−.4	0	9.3	w.	28	w.	12	17	11	2	3.1	.0	.0
South Pacific Coast Region							68.8											62	0.09	−0.1										2.1		
Fresno ¹	327	5	35	29.50	29.85	−.02	70.5		100	6	87	44	22	54	41	56	44	46	.00	−.2	0	6.0	nw.	22	nw.	11	27	3	0	.6	.0	.0
Los Angeles	338	223	250	29.51	29.86	−.02	68.0	−1.0	88	30	78	52	26	58	30	59	54	67	.00	−.2	0	6.1	w.	27	nw.	20	23	7	0	2.2	.0	.0
San Diego ¹	87	20	55	29.77	29.86	−.03	68.0		81	22	76	52	23	60	27	62	58	73	.28	+.2	1	6.5	w.	18	w.	30	12	17	1	3.6	.0	
West Indies																																
San Juan, P. R	82	10	54	29.84	29.92		80.6	+.1	89	14	85	74	20	76	15				5.05	−.9	19	10.5	e.	27	e.	24	3	22	5	5.9	.0	.0
Panama Canal																																
Balboa Heights	118	6	92		³29.81	−.01	80.3	+.5	92	30	87	71	18	74	18			³89	8.01	−.3	19	5.1	nw.	23	s.	20	0	18	12	7.2	.0	.0
Cristobal	36	6	97		³29.81	−.02	82.2	+1.8	91	25	86	73	5	77	15	76	75	³85	19.76	+7.1	20	5.7	s.	28	nw.	5	1	9	20	8.2	.0	.0
Alaska																																
Anchorage	132	6	47	⁴29.73	⁴29.88		48.4	+.6	65	5	56	30	16	40	28	46	42	75	.89	−1.7	8	4.8	n.	23	n.	20	6	9	15	6.3	.0	.0
Barrow	13	4	27	⁴30.03	⁴30.05		31.6	+.6	55	6	36	16	29	27	19	31	30		.72	+.2	9	13.5	e.				5	0	25	7.9	T	T
Bethel	38	6	32	⁴29.82	⁴29.85		46.6	+1.3	65	5	55	26	15	38	32	45	42	79	3.50	+.2	14		ne.				2	10	18	8.0	.0	.0
Fairbanks	484	11	87	⁴29.44	⁴29.96		44.0	+.4	67	4	54	23	23	34	36	40	33	67	.62	−.6	7	6.5	e.	27	sw.	9	7	10	13	6.2	T	.0
Juneau	80	96	116	⁴29.74	⁴29.88		51.0	+.6	71	9	58	39	19	44	27	47	43	78	5.65	−4.5	16	4.6	s.	18	se.	4	6	4	20	7.1	.0	.0
Ketchikan	75	69	85	⁴29.86	⁴29.88		53.5	−.1	71	10	60	38	19	47	25	50	47	81	13.68	+1.5	20	6.1	w.	23	s.	27	5	9	16	7.0	.0	.0
Nome	22	30	56	⁴29.87	⁴29.89		44.9	+3.2	62	6	52	26	14	38	24	43	38	72	.55	−2.2	7	12.2	ne.	38	e.	19	10	4	16	6.4	.0	.0
Hawaiian Islands																																
Honolulu	38	86	100	29.86	29.90		80.0	+1.8	88	22	84	72	12	75	13	72	68	70	.72	−.6	12	9.8	e.	25	e.	30	10	12	8	5.1	.0	.0

¹ Data are airport records.
² Barometric data (adjusted to old city elevation) and hygrometric data from airport; otherwise city office records.
³ Observations taken bihourly.
⁴ Pressure not reduced to a mean of 24 hours.
⁵ Barometric data from airport records, other data from city office records.
⁶ Wind, clear, partly cloudy and cloudy data from city office records, other data from airport.

NOTE.—Except as indicated by notes 1, 2, 5, and 6, data in table are city office records.

SEVERE LOCAL STORMS, SEPTEMBER 1941

[Compiled by Mary O. Souder]

[The table herewith contains such data as has been received concerning severe local storms that occurred during the month. A revised list of tornadoes will appear in the United States Meteorological Yearbook]

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Sarasota, Fla., vicinity of	1	5:30 p. m.	100	0	$600	Tornado	Small shed completely demolished, 2 barns and small cottage somewhat twisted and a truck overturned. No crop loss; path 50 miles long.
Teton County, Mont	2		[1] 5		100,000	Heavy hail	Loss in wheat, peas, flax, oats, barley, corn and beets. Few windows broken; car tops torn; path 10 miles long.
Des Moines, Iowa	3	A. m.				Heavy rain, electrical.	2 houses damaged by lightning; streets flooded; sewers inundated; traffic hampered.
Cassville, Wis	3	6 p. m.	88	0	1,000	Tornado	Storm moved from southwest to northeast. 2 persons injured; property damaged.
Wessington Springs, S. Dak., vicinity of.	3	11 p. m.—Midnight.	880		8,000	High wind	Property damage, $5,000; crop loss, $3,000; path 6 miles long.
Huron, S. Dak., and vicinity.	3	11:15–11:55 p. m.	[1] 2		4,000	do	Property damaged.
Winterset and Peru, Iowa	3				2,000	Electrical	In Winterset an oil station was damaged by lightning and a man stunned. In Peru a house burned and telephone switchboard was damaged interrupting long-distance service.
Day County, S. Dak	4	Midnight–1 a. m.	[1] 1		20,000	High wind	Buildings wrecked; farm machinery damaged; some corn down.
Minneapolis, St. Paul, White Bear Lake, Centerville, Minn., and vicinity.	4	12:17–12:33 p. m.	100	5	425,000	Tornado	The Soo Line R. R. shops demolished; about 200 freight cars overturned; 4 lake cottages wrecked and 36 cottages and other structures damaged; hundreds of trees uprooted; large brick schoolhouse partly destroyed; heavy metal signs badly twisted; large brick chimney toppled; many buildings unroofed, moved from their foundations, or otherwise damaged. Windows broken; billboards, signs, awnings, and radio tower down. Farm buildings demolished; poles and wires down and automobiles, airplanes, rowboats, and sailboats overturned. Corn was badly lodged; some livestock and poultry killed; about 50 persons injured. Path 30 miles long, but not continuous.
Wisconsin, western portion of State.	4		[1] 50	1	142,500	Wind	Much damage occurred from Burnett County northeastward to Bayfield County. Roofs on 2 buildings at munitions plant at Braksdale blown off; windows blown in; telephone and electric lines down and many tree uprooted. In Milwaukee a metal chimney and electric lines down; small boats in the harbor torn from their moorings; 40 persons injured.
Norfolk, Va	5	4:20 p. m.			1,000	Thunderstorm	Church struck by lightning and spire badly damaged.
Harrisburg, Pa.	5	P. m.				Wind	Trees blown down, limbs and branches torn off; traffic tied up; air service halted and light service interrupted.
Lancaster, Ohio, and vicinity.	5				75,000	Thunderstorm	Property damaged.
Toole County, Mont	6	2 p. m.	[1] 2		25,000	Hail	Principal loss in mustard crop; path 5 miles long.
Glacier County, Mont	6	3 p. m.	[1] 15		34,000	do	Principal loss in mustard crop; path 48 miles long.
Friend, Nebr	6	8-9 p. m.	[1] 10		2,000	Excessive rain	Several small county roads and bridges washed out; basements of several houses flooded.
Glenwood, Tabot, Randolph, and Farragut, Iowa.	6	P. m.			50,000	Hail and rain	Heavy hail broke windows; damaged automobiles and roofs and killed birds, as well as severely damaging crops, fruit trees and shrubbery along a line from Glenwood to Randolph. Heavy rain caused local flooding and loss in bottom-land crops. A railroad washout halted train service from Farragut to Hamburg from the 6th to 10th.
Saunders, Sarpy and Douglas Counties, Nebr.	6-7	8 p. m.–2 a. m.	[1] 20			Excessive rain	Flooding of highways and basements; 3 short railroad tracks washed out; path 50 miles long.
Prairie City, Fairmount, Reasnor, Killduff, Sully, Lynville, Searsboro and Evart, Iowa.	7	4:30 p. m.	440–1,760	0	140,000	Tornado and hail	The storm developed a few miles northeast of Prairie City and moved almost due east past and to the north of Fairmount, Reasnor, Killduff, Sully, and Lynville in Jasper County and of Searsboro in Poweshiek County, disappearing in the vicinity of Evart in Poweshiek County. Buildings were damaged or destroyed and total crop loss on about 80 farms and 5 persons were injured. Loss in growing crops not included in the estimate given.
Clinton, Iowa	7	9 p. m.			7,500	Rain, electrical and flood.	Property damaged; flooding caused a loss of 20 percent in 2,000 acres of corn.
Norton County, Kans	7	10–10:30 p. m.	[1] 6–10		350,000	Heavy hail	This considered to be the worst hailstorm in this vicinity in years. There was much property damage including automobile tops riddled, neon-tube signs shattered and much glass broken. Crop loss comparatively small and not estimated; path 25 miles long.
Cedar Rapids and Marion, Iowa.	7	P. m.			35,000	Wind, rain, electrical.	2 radio towers blown down; electric service interrupted; lightning caused several fires; streets flooded; roads, bridges and culverts badly damaged and railroads reported several washouts.
Moravia, Iowa, vicinity of	7				1,500	Electrical	Barn burned.
Anamosa and Olin, Iowa	7-8				$2,000	Wind, electrical and rain.	Heavy rain caused Buffalo River to overflow. Highway traffic delayed and foundations of buildings washed out in Anamosa. Near Olin on the 7th a barn burned with loss of $2,000. On the 8th wind damaged several farm buildings and flattened corn. Some livestock killed by lightning.
Delaware and Manchester, Iowa.	7-8	6 p. m.			2,000	Wind, electrical	Sections of Manchester flooded by overflow of the Maquoketa River. Loss to electric lines, $2,000. Several trees blown down; buildings damaged and some corn flattened.
Tahoka, Tex., vicinity of	8	3-5 p. m.	[1] 5		150,000	Hail and wind	Loss in cotton and grain sorghum. Considerable property damage not estimated.
Dane and Green Counties, Wis., and vicinities.	8		[1] 10		46,000	Wind	Several barns and silos wrecked; houses and garages damaged; trees and electric wires down; path 15 miles long.
Jackson County, Iowa	8				15,000	Wind, rain, electrical.	Widespread rain caused flooding and much erosion. Many small bridges and 2 railroad bridges west of Monmouth washed out. Southern half of Monmouth flooded. Severals roofs blown off and small trees uprooted.
Williamsport, Pa	10	3:25 p. m.	1,320			Wind, electrical	75 to 100 trees blown down or uprooted; 20 to 25 buildings damaged, some with roofs torn off; power lines down. Traffic halted and automobiles damaged by fallen trees and branches. Power cut off; windows smashed and awnings ruined.
Scranton, Pa., and vicinity	10	5:22 p. m.				do	Trees blown down; roads blocked; electric service disrupted. Houses struck by lightning causing several fires.
Newville, Pa., and vicinity	10	7 p. m.			3,500	Wind	Barn blown over, others unroofed; many trees down, 35 reported in 1 place.
Harrisburg, Pa., and vicinity.	10	P. m.			6,500	Electrical and wind.	Barn burned; 5 men stunned when another barn was struck.
Lancaster, Pa., and vicinity	10	do				Wind, hail, electrical.	Electric wires torn down; trees uprooted; buildings, including 5 tobacco sheds and a garage blown down; crops damaged by hail.
New York, central and northern counties.	10			1	250,000	Thunderstorm	Loss in crops and fruits; power and telephone lines damaged. In Westport a farmer was killed by lightning.
Mills, Montgomery, Adams, Cass, Fremont, and Page Counties, Iowa.	13-14				30,000	Wind, rain, and flood.	Excessively heavy, local rains, especially on the night of the 14th, in connection with thunderstorms, caused much damage by erosion over the southwestern corner of the State. Much corn was flattened by strong winds. No definite reports of the extent of the damage are available except from Fremont County, where roads were badly damaged and bridge approaches were washed out in the Randolph-Anderson area and Thurman and vicinity.
Minnesota, east-central counties.	14	A. m. and p. m.			38,500	Rain and flood	Highways and roads inundated; lowlands flooded with loss in growing crops.

[1] Miles instead of yards.

SEVERE LOCAL STORMS, SEPTEMBER 1941—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Duluth, Minn	14	2:10-4:35 p.m			$125,000	Rain and flood	Due to a prolonged wet period, the ground in this area was saturated before this storm started causing nearly all water to run off. 3.30 inches of rain recorded on the 14th with damage resulting mainly from flooding and caving in of basements in houses and business establishments. Much damage to streets and sewer systems; tracks of railroads near the edge of the lake undermined; and electric service interrupted.
Gilman, Minn., and vicinity	14	3:45 p. m	275		60,000	Possible tornado	Several barns demolished; many residences and buildings damaged; trees uprooted, haystacks scattered, corn flattened, and poultry killed. Length of path 8 miles, from southwest to northeast. A funnel cloud observed 5 miles southwest of Gilman. Property damage, $50,000; loss in growing crops, $10,000.
Halbur, Iowa, vicinity of	14	4:30 p. m			3,000	Wind	Property damaged, $1,000; corn flattened, $2,000.
Hornick, Iowa, vicinity of	14				4,000	Rain and wind	Property damaged.
Lancaster County, Nebr., southern portion.	14-15	3 p. m.-5 a. m.	[1] 5		20,000	Rain	Creeks overflowed, flooding highways, homes, and fields, causing floods in the Blue and Nemaha Rivers.
Rochester, Albert Lea, and Weaver, Minn., and vicinities.	15	A. m. and p. m.			15,000	Rain and flood	Heavy to excessive rains in connection with a severe thunderstorm caused much damage to highways and bridges. Basements flooded and streets washed out. At Weaver a hillside washed over a highway. Some loss in growing crops.
Hallock, Minn., and vicinity	15	4-6 p. m			2,000	Thunderstorm and hail.	Storm moved from northwest to southeast and was accompanied by high winds. Property damage, $500; loss to growing crops, $1,500.
Denton to Rokeby, Nebr	15	6-7 p. m	[1] 5		1,000	Hail and rain	Creeks flooded; small hail damage.
Guthrie Center to Dike, Iowa, and vicinities.	15	9 p. m	[1] 2-3		15,000	Tornadic wind	Trees and branches blown down and windmills and small buildings wrecked, and some corn flattened. Near Dike a new, substantial barn totally wrecked.
Cassville, Wis., vicinity of	15				1,500	Wind	Barn and some buildings damaged.
Sloan, Iowa, vicinity of	21	2 p. m			900	do	Buildings in small area damaged; boy cut by flying glass.
Ogden, Logan, and Farmington, Utah, and vicinities.	21-22	P. m			250,000	do	An airplane hangar at the old Municipal airport and a small brick apartment, both under construction, were demolished, together with a number of small airplanes stored in the hangar. A firehouse in north Ogden partly destroyed and many residences in eastern portion of the city damaged. Several hundred shade trees down. Loss in crops, $100,000. There was extensive loss in apples and ensilage corn crops and in a lesser degree to prunes and pears. Apples were blown from trees and corn flattened. Total estimated loss in Ogden, $100,000. Two persons injured and power, light, and telephone service was interrupted. Structural damage in a much less degree occurred in Logan and Farmington, with widespread disruption to power and telephone service in the entire area.
Mesa Service Station, N. Mex.	23	4-5:30 p. m	[1] 15			Heavy hail	20 sections of range grass damaged.
Lookeba, Okla	24	5-5:30 p. m	[1] 5		500	Hail and wind	Loss in cotton and corn; path 20 miles long.
Erie, Pa., and vicinity	25				600	Wind	Damage to telephone lines and trees; 2 automobiles damaged by falling signs.
Indiana	25				100,000	Tropical disturbance.	High winds general over the entire State with considerable loss, especially to apples. Some trees and wires down and property damaged.
New York State, counties bordering on Lakes Erie and Ontario and the upper St. Lawrence.	25				2,000,000	Wind	This storm of tropical origin, is reported as being the worst in any September in these areas. Maximum wind velocities ranged from 40 to 60 miles per hour. There was severe damage to orchards, telephone, telegraph and electric power lines, and considerable damage to buildings, small craft, automobiles, etc. The amount estimated for damage in western New York, only. The New York State Department of Agriculture reported loss in 1,500,000 bushels of apples.
Ohio, entire State	25			1		do	Considerable damage to property and heavy loss to orchardists. Several persons injured. Estimate of damage not given.

[1] Miles instead of yards.

SOLAR RADIATION AND SUNSPOT DATA FOR SEPTEMBER 1941

[Solar Radiation Investigations Section, I. F. HAND in charge]

SOLAR RADIATION OBSERVATIONS

By SYLVIA NEEDRE

Measurements of solar radiant energy received at the surface of the earth are made at 9 stations maintained by the Weather Bureau and at 12 cooperating stations maintained by other institutions. The intensity of the total radiation from sun and sky on a horizontal surface is continuously recorded (from sunrise to sunset) at all these stations by self-registering instruments; pyrheliometric measurements of the intensity of direct solar radiation at normal incidence are made at frequent intervals on clear days at three Weather Bureau stations (Madison, Wis.; Lincoln, Nebr.; and Albuquerque, N. Mex.) and at the Blue Hill Observatory at Harvard University. Occasional observations of sky polarization are taken at the Weather Bureau station at Madison and at Blue Hill Observatory.

The geographic coordinates of the stations, descriptions of the instrumental equipment, station exposures, and methods of observation, together with summaries of the data obtained, up to the end of 1939, are given in the MONTHLY WEATHER REVIEW for December 1937, April 1941, and September 1941.

Table 1 contains the measurements of the intensity of direct solar radiation at normal incidence, with means and their departures from normal (means based on less than 3 values are in parentheses). At Lincoln, Madison, Albuquerque, and Blue Hill the observations are obtained with a recording thermopile, checked by observations with a Smithsonian silver-disk pyrheliometer at Blue Hill. The table also gives vapor pressures at 7:30 a. m. and at 1:30 p. m. (75th meridian time).

Table 2 contains the daily total amounts of radiation received on a horizontal surface from both sun and sky for all stations except Fairbanks, Alaska; and also the weekly means, their departures from normal and the accumulated departures since the beginning of the year. The values at most of the stations are obtained from the Eppley pyrheliometer recording either on a microammeter or a potentiometer. If the daily figures for total solar and sky radiation at Fairbanks should be desired, they may be obtained approximately 2 months after the date of the observation by writing to the Solar Radiation Investigations Supervisory Station, Blue Hill Observatory, Milton, Mass.

Beginning with this issue, ultraviolet values obtained at San Juan will be included in table 2. These data represent the radiation below 3132 Ångströms received on a horizontal surface. The unit is 1 milligram calorie, or one-thousandth of a gram calorie (see Kenrick and Ortiz, Measurements of Ultraviolet Solar Radiation in

Puerto Rico, *Trans. Amer. Geophys. Union* (Section of Meteorology), volume 38, pp. 134–140, April 1938; and Studies in Solar Radiation and Their Relationship to Biophysics and the General Problem of Climate and Health, by G. W. Kenrick and George Del Toro, Jr., *Puerto Rico Journal of Public Health and Tropical Medicine*, June 1940, volume 15, No. 4, Columbia University Press. Pending international agreement, Coblentz intends using 3200 Å as the wavelength limit; see The Spectral Range of Ultraviolet Solar Radiation Useful in Bioclimatology, by W. W. Coblentz, *Bulletin American Meteorological Society*, October 1941, pp. 316–318.)

Through the courtesy of Dr. O. C. Magistad, Assistant Chief of the Bureau of Plant Industry, United States Department of Agriculture, and Dr. L. A. Richards, Director of the United States Regional Laboratory at Riverside, Calif., we include this month about 1 year's record of total solar and sky radiation received on a horizontal surface at Indio and Torrey Pines, Calif. A comparison of these values with those obtained at La Jolla and Riverside is interesting because of the relatively close proximity of the four stations and their widely divergent totals. The pyrheliometer at La Jolla is located on one of the laboratory buildings of the Scripps Institution of Oceanography about 100 feet from the Pacific Ocean. The early morning fogs over this station result in much lower average morning values of radiation than at Torrey Pines, located on a bluff about 7 miles inland from La Jolla. The San Jacinto range lies between Riverside and Indio, with Riverside in the citrus belt and Indio in the date palm region 100 feet below sea level in the Imperial Valley. While Indio receives a very high percentage of sunshine, the region is visited frequently by severe duststorms.

Table 1 shows that normal incidence radiation averaged slightly above normal for the month at all three stations for which means have been computed.

Table 2 shows an excess in the amount of total solar and sky radiation received on a horizontal surface during September at all stations for which normals have been computed with the exception of Lincoln, Albuquerque and Friday Harbor, which is slightly below normal.

Polarization measurements made on 6 days at Madison give a mean of 70 percent with maxima of 76 percent of the 6th and 17th. All of these values are close to average for September.

The results of recalibration of instruments throughout the United States are given in a paper which appears on page 262 of this REVIEW.

TABLE 1.—*Solar radiation intensities during September 1941*

[Gram-calories per minute per square centimeter of normal surface]

MADISON, WIS.

Date	Sun's zenith distance										
	7:30 a. m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	1:30 p. m.
	75th mer. time	Air mass									Local mean solar time
		A. M.					P. M.				
	e.	5.0	4.0	3.0	2.0	[1] 1.0	2.0	3.0	4.0	5.0	e.
	mm.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm.*
Sept. 6	9.83	0.90	1.02	1.13	1.28	1.46					7.57
Sept. 10	7.57	.96	1.06	1.14	1.30	1.48					8.18
Sept. 17	8.81	.98	1.06	1.19	1.35	1.49	1.31				9.14
Sept. 18	7.78	.74	.88	1.02	1.18	1.42	1.22				8.48
Sept. 22	12.68	.53	.71	.91	1.07	1.34	1.08				12.24
Sept. 26	5.16	.74	.71	.79	1.22	1.47	1.15	1.03			5.36
Means		**.81**	**.91**	**1.03**	**1.23**	**1.44**	**1.19**	**1.03**			
Departures		**+.05**	**+.03**	**+.03**	**+.08**	**+.05**	**+.04**				

TABLE 1.—*Solar radiation intensities during September 1941*—Con.

LINCOLN, NEBR.

Date	Sun's zenith distance										
	7:30 a. m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	1:30 p. m.
	75th mer. time	Air mass									Local mean solar time
		A. M.					P. M.				
	e.	5.0	4.0	3.0	2.0	[1] 1.0	2.0	3.0	4.0	5.0	e.
	mm.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm.*
Sept. 5	10.21				1.23		1.21				7.87
Sept. 6	11.38				1.08						16.79
Sept. 9	8.18						1.25	1.10	0.97	0.88	7.57
Sept. 10	7.87		0.90	1.03	1.20		1.14	.96	.84	.71	9.14
Sept. 11	9.47		.96	1.08	1.23		1.21	1.06	.92	.79	9.47
Sept. 16	13.13				1.14		1.19	1.03	.90	.82	10.21
Sept. 18	15.11	0.71	.82	.94	1.13						16.79
Sept. 19	16.79	.64			1.10						16.21
Sept. 20	16.79	.71	.84	.96	1.10						16.21
Sept. 22	11.38							.94	.84	.75	14.10
Sept. 23	10.59			.79	1.08						11.38
Sept. 26	6.76	.77	.88	1.05	1.21		1.10				7.57
Sept. 30	7.04		.96	1.11	1.29						10.21
Means		**.71**	**.89**	**.99**	**1.16**		**1.18**	**1.02**	**.89**	**.79**	
Departures		**−.03**	**−.04**	**−.02**	**+.01**		**+.02**	**+.04**	**+.05**	**+.05**	

BLUE HILL, MASS.

Sept. 3	7.6	0.79	0.90	1.00			1.25	1.12	1.02	0.94	8.8
Sept. 6	14.7								.75	.64	11.1
Sept. 7	10.3	.65	.76	(.91)	1.12	1.25					
Sept. 8	7.1	.86	.95	1.06	1.19	1.42	1.20	.97			7.9
Sept. 9	8.8			.90							10.7
Sept. 12	6.5	.96	1.04								5.8
Sept. 13	5.4	.97	1.05			1.44	1.22	1.03	.87	.74	3.8
Sept. 16	13.2	.51	.60	.75					.73	.67	15.8
Sept. 18	8.8	.87	.95								5.6
Sept. 19	6.3	.90									5.2
Sept. 20	6.5		1.03	1.15	1.27			1.06	.91		6.1
Sept. 21	8.8	.75	.86	.98	1.15		1.12	.95	.81	.69	7.4
Sept. 22	9.9	.79	.91	1.02	1.17				.82		8.8
Sept. 23	8.6	.67	.72	.83	1.03						12.3
Sept. 24	8.8	.67	.77	.92	1.08						10.3
Sept. 25	9.2					1.49	1.22	1.08	(.84)	(.79)	8.2
Sept. 30	3.2		.98	(1.09)							4.4
Means		**.78**	**.89**	**.96**	**1.14**	**1.40**	**1.20**	**1.04**	**.84**	**.75**	
Departures		**−.02**	**−.02**	**−.06**	**+.01**	**+.03**	**+.07**	**+.10**	**+.04**	**+.07**	

ALBUQUERQUE, N. MEX.

Sept. 1	13.15						1.21	1.08	0.90	0.80	11.38
Sept. 2	12.24	0.81	0.90	1.03	1.16	1.42	1.17				11.38
Sept. 4	5.36						1.31	1.14	1.02	.91	6.02
Sept. 5	3.59					1.56	1.34	1.20	1.08	.95	4.75
Sept. 7	7.57	.84	.95	1.07	1.24		1.29	1.14	1.02	.88	7.29
Sept. 8	7.04	.91	1.04	1.13	1.30						6.50
Sept. 9	6.76						1.32	1.18	1.01	.90	5.56
Sept. 10	4.36	.86	1.01	1.12	1.31	1.49			1.04		7.87
Sept. 11	7.57	.90	1.01	1.12	1.34		1.30	1.17	1.06	.97	7.87
Sept. 15	10.20	.88	1.02	1.14	1.28	1.52	1.30		1.04	.95	8.49
Sept. 16	5.79	.94	1.03	1.14	1.27	1.49	1.30	1.16	1.07	.97	6.27
Sept. 17	8.49	.85	.95	1.07	1.19	1.47	1.25	1.08	.98	.90	9.14
Sept. 18	10.20			1.08		1.49	1.25	1.09	.99		10.20
Sept. 19	11.81	.82	.94	1.05	1.19	1.48					11.81
Sept. 20	11.81		.95								12.24
Sept. 21	10.98	.88		1.13	1.27						9.83
Sept. 22	9.46							1.14	.99	.88	9.46
Sept. 23	8.18		1.05	1.16	1.31	1.55	1.27	1.14	1.01	.93	6.76
Sept. 24	5.36		1.01	1.14	1.30	1.53	1.29	1.14	1.03	.94	4.75
Sept. 25	4.95	.99	1.12	1.20	1.34		1.35	1.14	1.12	1.01	5.15
Sept. 27	7.87	.88	1.00	1.13	1.29						9.46
Sept. 29	6.27						1.28	1.14	1.03	.94	8.81
Sept. 30	8.18				1.29		1.30	1.14	.99	.92	8.81
Means		**.88**	**1.00**	**1.11**	**1.27**	**1.50**	**1.28**	**1.14**	**1.02**	**.92**	

LATE DATA

Blue Hill, Mass.

July 3	9.6				0.99	[1] 1.17					10.7
July 5	11.9							0.70	0.59		11.9
July 6	12.8	0.58	0.70	0.78	.97			.98	.89		11.5
July 10	11.5	.52	.64	.89	.99						9.6
July 14	13.7			.99							11.1
July 15	10.7					[1] 1.27	0.96	.82	.71		11.9
July 16	11.5							.71	.51		13.2
July 21	10.3	.77	.87	1.03	1.13	[1] 1.28	.92	.72	.60	0.47	9.9
July 22	10.7	.43	.51	.63	.83						12.8
July 26	17.5						1.02				15.3
July 27	14.3				1.00				.69		10.7
Mean		**.58**	**.68**	**.85**	**.99**	**1.24**	**.97**	**.79**	**.67**	**.47**	
Departure		**−.03**	**−.01**	**−.02**	**−.06**	**−.02**	**−.04**	**−.06**	**−.04**	**−.18**	

[1] Extrapolated.

TABLE 1.—*Solar radiation intensities during September 1941*—Con.

LATE DATA—Continued

Blue Hill, Mass.—Continued

[Gram-calories per minute per square centimeter of normal surface]

Date	7:30 a. m. 75th mer. time	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	1:30 p. m. Local mean solar time
		Air mass A. M.					Air mass P. M.				
	e.	5.0	4.0	3.0	2.0	[1] 1.0	2.0	3.0	4.0	5.0	e.
	mm.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm.*
August 2	15.3							.63	.54	.49	13.7
August 3	12.3	.47	.57	.71	.89	1.00					11.9
August 4	11.9	.56		.79	.96						13.2
August 5	13.2	.62		.84	.96						11.5
August 6	11.5	.49		.72	.86						10.7
August 7	9.6	.43	.52	.66	.89						8.8
August 8	11.9	.49	.60	.73		1.27	.94	.75	.65	.56	11.5
August 9	11.9	.78	.85	.91	1.02						12.3
August 10	11.9		.95	1.03	1.13	1.24					9.2
August 11	8.2	.77	.87	.98	1.10	1.28					9.6
August 17	9.2					1.29					5.8
August 21	9.9	.81	.94								11.1
August 22	12.1							.76	.65	.54	13.2
August 24	8.8	.82	.89	.99	1.12			.95	.81	.68	8.6
August 28	6.1	.89	.98	1.11	1.19		1.17	1.01	.87	.78	5.8
Mean		**.65**	**.80**	**.86**	**1.01**	**1.23**	**1.06**	**.82**	**.70**	**.61**	
Departure		**−.02**	**−.03**	**−.05**	**−.05**	**−.05**	**+.01**	**−.05**	**+.01**	**+.03**	

TABLE 1.—*Solar radiation intensities during September 1941*—Con.

LATE DATA—Continued

Blue Hill, Mass.—Continued

[Gram-calories per minute per square centimeter of normal surface]

Date	7:30 a. m. 75th mer. time	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	1:30 p. m. Local mean solar time
		Air mass A. M.					Air mass P. M.				
	e.	5.0	4.0	3.0	2.0	[1] 1.0	2.0	3.0	4.0	5.0	e.
	mm.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm.*
September 3	7.6	.79	.90	1.00			1.25	1.12	1.02	.94	8.8
September 6	14.7								.75	.64	11.1
September 7	10.3	.65	.76	(.91)	1.12	1.25					
September 8	7.1	.86	.95	1.06	1.19	1.42	1.20	.97			7.9
September 9	8.8			.90							10.7
September 12	6.5	.96	1.04								5.8
September 13	5.4	.97	1.05			1.44	1.22	1.03	.87	.74	3.8
September 16	13.2	.51	.60	.75					.73	.67	15.8
September 18	8.8	.87	.95								5.6
September 19	6.3	.90									5.2
September 20	6.5		1.03	1.15	1.27			1.06	.91		6.1
September 21	8.8	.75	.86	.98	1.15		1.12	.95	.81	.69	7.4
September 22	9.9	.79	.91	1.02	1.17				.82		8.8
September 23	8.6	.67	.72	.83	1.03						12.3
September 24	8.8	.67	.77	.92	1.08						10.3
September 25	9.2					1.49	1.22	1.08	(.84)	(.79)	8.2
September 30	3.2		.98	(1.09)							4.4
Mean		**.78**	**.89**	**.96**	**1.14**	**1.40**	**1.20**	**1.04**	**.84**	**.75**	
Departure		**−.02**	**−.02**	**−.06**	**.00**	**+.03**	**+.07**	**+.10**	**+.04**	**+.07**	

TABLE 2.—*Daily totals and weekly means of solar radiation (direct + diffuse) received on a horizontal surface*

[Gram-calories per square centimeter]

	Washington	Madison	Lincoln	New York	Chicago	Fresno	Albuquerque	Fairbanks	Newport	Ithaca	Cambridge	Blue Hill	Friday Harbor	Riverside	New Orleans	La Jolla	State College	San Juan	San Juan U. V. below 3132 Å.
	cal.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*Milli. cal.*
Sept. 3	224	206	446	440	290	596	578		580		548	567	93	511	542	533	173	522	365
Sept. 4	106	328	443	117	406	583	618		388		435	408		538	551	384	212	450	211
Sept. 5	326	506	559	258	468	573	621		159		161	99	476	511	569	241	439	94	283
Sept. 6	545	524	438	546	544	563	465		525		518	501	487	511	563	498	509	90	153
Sept. 7	476	375	492	522	482	573	597		524		531	502	256	476	418	538	303		239
Sept. 8	487	110	360	571		574	560		561		553	567	213	539	523	514	562	565	432
Sept. 9	499	87	488	360	364	555	613		247		288	307	378	510	431	446	503	525	311
Mean	381	305	461	402	426	574	579	275	426		433	422	332	514	514	451	386	502	293
Departure	−11	−70	+17	+65	+61	+12	+23	+68	−39		+45	+29	−82	+44	+92	−37			
Sept. 10	465	542	522	409	545	543	535		209		376	410	286	537	526	576	374	366	301
Sept. 11	534	331	538	522	549	563	535		451		495	457	378	487	359	429	473	499	416
Sept. 12	568	477	493	583	488	558	535		538		500	500		489	496	518	585	469	433
Sept. 13	504	466	128	501	463	546	294		546		525	574		502	261	428	553	148	246
Sept. 14	544	395	268	491	489	556			506		470	467		498	149	552	556	239	281
Sept. 15	538	145	328	446	410	544			469		477	464		521	394	542	503	284	180
Sept. 16	522	356	528	431	249	529	568		455		390	453		515	310	487	505	298	152
Mean	525	387	401	483	456	548	494	174	454		462	475		507	356	505	507	431	295
Departure	+148	+43	−18	+154	+125	+21	−4	−24	+49		+70	+96		+61	−2	+5			
Sept. 17	483	513	404	411	530	513	506		420		399	426		457	355	264	348	301	184
Sept. 18	461	479	466	508	548	529			516		506	520	395	406	518	430	532	475	396
Sept. 19	504	463	456	516	486	517	525		539		492	513	215	517	596	345	544	499	347
Sept. 20	526	423	466	503	450	532			526		457	512	321	499	587	506	519	250	374
Sept. 21	458	423	290	435	463	527	295		515		469	488	320	529	318	527	522		309
Sept. 22	462	436	360	353	427	527	260		468		451	477		536	100	543	442	336	353
Sept. 23	490	328	459	447	373	518	548		432		393	424		523	440	536	447	420	297
Mean	483	438	414	453	468	523	427	238	488		452	480	313	495	416	450	479	424	311
Departure	+109	+87	+1	+141	+117	+36	−33	+64	+93		+76	+104	−11	+26	+40	+30			
Sept. 24	427	320	75	399	362	515	549		474		377	314		504	284	506	441	403	307
Sept. 25	306	173	356	441	93	481	584		455		387	449		483	371	478	145	432	314
Sept. 26	379	452	446	370	456	478	459		395		443	425	251	489	392	514	342	465	309
Sept. 27	415	346	287	418	408	481	354		351		336	330	368	478	410	468	448	176	131
Sept. 28	426	119	254	225	89	463	130		306		379	364	94	399	461	403	415	228	94
Sept. 29	418	287	42	303	254	476	314		366		338	390	252	351	548	284	303	449	313
Sept. 30	210	167	437	300	104	481	525		331		267	356	261	476	525	481	395	465	333
Mean	369	266	271	351	252	482	416	170	382		361	377	245	454	427	448	355	377	258
Departure	+18	−32	−93	+66	−34	+33	−16	+34	+39		+42	+35	−57	+3	+46	+55			

ACCUMULATED DEPARTURES ON SEPTEMBER 30

	Washington	Madison	Lincoln	New York	Chicago	Fresno	Albuquerque	Fairbanks	Newport	Ithaca	Cambridge	Blue Hill	Friday Harbor	Riverside	New Orleans	La Jolla	State College	San Juan	San Juan U. V.
	+5,005	+3,549	−6,083	+17,731	+15,330	−1,246		−1,596	−2,128		+1,680	−84		−197	+11802	−3,472			

TABLE 2.—*Daily totals and weekly means of solar radiation (direct + diffuse) received on a horizontal surface*—Continued

LATE DATA

	1940, week beginning—												
	July 1	July 8	July 15	July 22	July 29	Aug. 5	Aug. 12	Aug. 19	Aug. 26	Sept. 2	Sept. 9	Sept. 16	Sept. 23
	cal.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Indio, Calif.	748	667	766	688	698	641	638	638	573	581	544	513	498
Torrey Pines, Calif.	594	700	663	----------	----------	616	521	587	549	544	546	453	483

	Week beginning—												
	Sept. 30	Oct. 7	Oct. 14	Oct. 21	Oct. 28	Nov. 4	Nov. 11	Nov. 18	Nov. 26	Dec. 5	Dec. 9	Dec. 16	Dec. 23
	cal.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Indio, Calif.	463	482	444	385	397	382	----------	298	330	290	241	207	174
Torrey Pines, Calif.	452	430	425	340	394	342	----------	----------	----------	----------	----------	----------	----------

	1941, week beginning—												
	Jan. 1	Jan. 8	Jan. 15	Jan. 22	Jan. 29	Feb. 5	Feb. 12	Feb. 19	Feb. 26	Mar. 5	Mar. 12	Mar. 19	Mar. 26
	cal.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Indio, Calif.	301	----------	----------	----------	350	325	319	381	330	472	423	564	498
Torrey Pines, Calif.	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------

	Week beginning—												
	Apr. 2	Apr. 9	Apr. 16	Apr. 23	Apr. 30	May 7	May 14	May 21	May 28	June 4	June 11	June 18	June 25
	cal.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Indio, Calif.	621	520	625	628	632	727	732	683	712	712	740	763	751
Torrey Pines, Calif.	624	407	686	399	499	682	590	651	632	496	562	692	----------

POSITIONS, AREAS, AND COUNTS OF SUN SPOTS FOR SEPTEMBER 1941

[Communicated by Capt. J. F. Hellweg, U. S. Navy (Ret.), Superintendent, U. S. Naval Observatory.] All measurements and spot counts were made at the Naval Observatory from plates taken at the observatories indicated. Difference in longitude is measured from the central meridian, positive toward the west. Latitude is positive toward the north. Areas are corrected for foreshortening and expressed in millionths of Sun's hemisphere. For each day, under longitude, latitude, area of spot or group, and spot count, are included assumed longitude of center of the disk, assumed latitude of center of the disk, total area of spots and groups, and total spot count.

Date	Eastern standard time	Mount Wilson group No.	Heliographic: Difference in longitude	Heliographic: Longitude	Heliographic: Latitude	Heliographic: Distance from center of disk	Area of spot or group	Spot count	Plate quality	Observatory
1941	h m		°	°	°	°				
Sept. 1	10 40	7275	−67	344	+3	67	24	6	G	U. S. Naval.
		7274	−64	347	−9	65	291	10		
		7273	−59	352	+13	59	97	9		
		7272	−50	1	−16	54	24	3		
		7269	−6	45	+10	6	97	7		
		7264	+78	129	+13	78	388	9		
				(51)	(+7)		921	44		
Sept. 2	11 25	7275	−54	344	+3	54	18	4	VG	Do.
		7274	−50	348	−8	53	291	12		
		7273	−43	355	+13	43	315	22		
		7272	−35	3	−15	41	24	2		
		7269	+8	46	+9	9	48	9		
		7276	+50	88	+14	50	48	4		
		(*)	+59	97	−4	61	24	6		
		7264	+88	126	+14	88	145	1		
				(38)	(+7)		913	60		
Sept. 3	11 37	7274	−35	350	−8	38	291	12	G	Do.
		7273	−29	356	+13	30	242	20		
		7272	−22	3	−15	31	24	3		
		7269	+21	46	+10	22	24	2		
				(25)	(+7)		581	37		
Sept. 4	11 34	7277	−66	305	+12	67	12	1	G	Mt. Wilson.
		7274	−21	350	−8	26	291	12		
		7273	−20	351	+15	22	48	1		
		7273	−11	0	+12	13	145	15		
		7269	+36	47	+9	36	24	5		
				(11)	(+7)		520	34		

POSITIONS, AREAS, AND COUNTS OF SUN SPOTS FOR SEPTEMBER 1941—Continued

Date	Eastern standard time	Mount Wilson group No.	Heliographic: Difference in longitude	Heliographic: Longitude	Heliographic: Latitude	Heliographic: Distance from center of disk	Area of spot or group	Spot count	Plate quality	Observatory
1941	h m		°	°	°	°				
Sept. 5	12 23	7277	−52	306	+12	52	48	5	G	U. S. Naval.
		7273	−7	351	+15	11	48	10		
		7274	−6	352	−8	16	291	14		
		7273	+3	1	+12	6	97	8		
				(358)	(+7)		484	37		
Sept. 6	10 50	7277	−39	306	+12	39	48	10	VG	Do.
		7274	+6	351	−7	15	364	24		
		7273	+7	352	+14	10	24	4		
		7273	+16	1	+12	17	48	7		
				(345)	(+7)		484	45		
Sept. 7	14 35	7278	+5	335	−9	17	48	9	G	Do.
		7274	+21	351	−7	26	388	16		
		7273	+31	1	+12	32	48	10		
				(330)	(+7)		484	35		
Sept. 8	10 59	7278	+19	338	−9	25	97	10	VG	Do.
		7279	+29	348	−3	32	36	6		
		7274	+35	354	−7	38	412	22		
		7273	+43	2	+14	44	97	11		
				(319)	(+7)		642	49		
Sept. 9	11 21	7278	+32	337	−9	35	73	8	G	Do.
		7274	+43	348	−7	45	48	15		
		7274	+49	354	−7	51	339	1		
		7273	+50	4	+12	60	73	1		
				(305)	(+7)		533	25		
Sept. 10	11 23	7281	−81	211	+10	81	485	3	G	Do.
		7280	−67	225	−8	69	12	1		
		7278	+45	337	−9	47	24	6		
		7274	+61	353	−7	63	339	4		
		7273	+72	4	+12	72	73	1		
				(292)	(+7)		933	15		

POSITIONS, AREAS, AND COUNTS OF SUN SPOTS FOR SEPTEMBER 1941—Continued

Date	Eastern standard time	Mount Wilson group No.	Heliographic: Difference in longitude	Heliographic: Longitude	Heliographic: Latitude	Heliographic: Distance from center of disk	Area of spot or group	Spot count	Plate quality	Observatory
1941	*h* *m*		°	°	°	°				
Sept. 11	11 16	7281	−88	191	+10	88	97	2	G	U. S. Naval.
		7281	−73	206	+11	73	824	12		
		7283	−70	209	+18	71	194	7		
		7280	−50	229	−10	53	24	3		
		7282	−21	258	−10	27	24	4		
		7278	+60	339	−8	62	12	1		
		7274	+75	354	−7	76	339	1		
				(279)	(+7)		1,514	30		
Sept. 12	11 31	7281	−69	197	+8	69	48	3	G	Do.
		7281	−63	203	+11	63	315	7		
		7283	−55	211	+18	55	291	10		
		7281	−53	213	+11	53	606	5		
		7280	−35	231	−10	38	24	5		
		7282	−9	257	−10	19	24	2		
		7278	+80	346	−8	80	12	1		
				(266)	(+7)		1,320	33		
Sept. 13	10 41	7281	−56	197	+8	56	12	1	G	Do.
		7281	−51	202	+11	51	242	1		
		7281	−41	212	+11	41	630	15		
		7283	−41	212	+18	42	436	16		
		7280	−20	233	−10	27	24	4		
		7284	+3	256	+8	3	48	7		
		7282	+5	258	−9	17	12	1		
				(253)	(+7)		1,404	45		
Sept. 14	10 55	7281	−42	198	+8	42	24	3	VG	Mt. Wilson.
		7281	−39	201	+11	39	315	7		
		7281	−28	212	+11	28	824	19		
		7283	−28	212	+18	30	436	14		
		7280	−7	233	−8	17	24	5		
		7284	+18	258	+7	18	12	1		
		7285	+25	265	+16	26	24	1		
				(240)	(+7)		1,659	50		
Sept. 15	10 55	7281	−34	192	+11	35	24	1	VG	U. S. Naval.
		7281	−29	197	+8	29	12	1		
		7281	−24	202	+11	25	533	14		
		7281	−23	203	+8	24	12	1		
		7281	−13	213	+11	13	824	25		
		7283	−13	213	+18	17	533	21		
		7280	+9	235	−9	18	97	8		
		7286	+40	266	+10	40	24	5		
				(226)	(+7)		2,059	76		
Sept. 16	10 53	7287	−68	145	−12	70	133	6	VG	Do.
		7281	−20	193	+11	21	12	3		
		7281	−10	203	+11	12	630	28		
		7283	−2	211	+18	12	485	18		
		7281	0	213	+10	3	1,067	63		
		7280	+22	235	−9	27	97	13		
		7278	+51	264	+10	51	24	3		
				(213)	(+7)		2,448	134		
Sept. 17	11 10	7289	−80	120	+17	80	194	3	VG	Do.
		7288	−57	143	+8	57	24	3		
		7287	−55	145	−12	58	242	9		
		7281	+1	201	+11	4	388	7		
		7281	+7	207	+11	8	630	35		
		7283	+11	211	+18	17	436	30		
		7281	+13	213	+11	15	1,164	55		
		7280	+36	236	−9	39	97	15		
				(200)	(+7)		3,175	157		
Sept. 18	10 45	7289	−67	120	+16	68	97	6	G	Do.
		7288	−42	145	+8	42	36	1		
		7287	−41	146	−12	44	242	12		
		7281	+8	195	+11	10	36	6		
		7281	+13	200	+11	13	436	3		
		7281	+20	207	+11	21	630	25		
		7283	+25	212	+19	27	242	16		
		7281	+27	214	+11	27	1,164	40		
		7280	+50	237	−9	52	121	18		
				(187)	(+7)		3,004	127		

POSITIONS, AREAS, AND COUNTS OF SUN SPOTS FOR SEPTEMBER 1941—Continued

Date	Eastern standard time	Mount Wilson group No.	Heliographic: Difference in longitude	Heliographic: Longitude	Heliographic: Latitude	Heliographic: Distance from center of disk	Area of spot or group	Spot count	Plate quality	Observatory
1941	*h* *m*		°	°	°	°				
Sept. 19	11 24	7289	−53	120	+16	53	24	4	VG	U. S. Naval.
		7288	−28	145	+8	28	48	1		
		7287	−27	146	−12	33	291	16		
		7281	+28	201	+12	29	339	6		
		7281	+32	205	+12	32	630	25		
		7283	+37	210	+19	38	242	26		
		7281	+41	214	+12	41	1,164	50		
		7280	+63	236	−9	65	121	14		
				(173)	(+7)		2,850	142		
Sept. 20	10 45	7287	−14	146	−12	24	242	13	G	Do.
		7288	−12	148	+7	12	48	1		
		7281	+41	201	+11	41	388	8		
		7281	+47	207	+11	47	630	20		
		7283	+49	209	+18	49	242	20		
		7281	+55	215	+11	55	1,067	30		
		7280	+76	236	−9	76	48	4		
				(160)	(+7)		2,665	96		
Sept. 21	11 6	7290	−7	140	+9	8	24	3	F	Mt. Wilson
		7287	−3	144	−14	21	48	6		
		7287	+3	150	−11	18	194	1		
		7288	+4	151	+6	5	48	4		
		7281	+58	205	+12	58	388	5		
		7281	+65	212	+12	65	1,697	25		
		7283	+65	212	+19	65	194	10		
				(147)	(+7)		2,593	54		
Sept. 22	11 40	7290	+8	142	+9	8	48	7	G	U. S. Naval
		7287	+10	144	−15	25	24	4		
		7287	+14	148	−12	23	194	2		
		7288	+18	152	+6	18	24	1		
		7292	+33	167	+15	34	48	9		
		7281	+69	203	+12	69	388	6		
		7281	+80	214	+11	80	1,697	25		
		7283	+80	214	+19	80	48	8		
				(134)	(+7)		2,471	62		
Sept. 23	11 1	(*)	−78	43	+17	78	12	3	VG	Do.
		7290	+22	143	+9	22	73	13		
		7287	+28	149	−12	33	194	1		
		7288	+31	152	+5	31	24	4		
		7292	+49	170	+15	49	242	20		
		7281	+85	206	+12	85	727	4		
				(121)	(+7)		1,272	45		
Sept. 24	10 59	7294	+10	118	+15	14	12	1	F	Do
		7293	+29	137	−13	35	24	4		
		7290	+35	143	+9	35	73	12		
		7287	+41	149	−12	45	194	1		
		7288	+44	152	+5	44	24	1		
		7292	+61	169	+15	61	291	6		
				(108)	(+7)		618	25		
Sept. 25	10 38	7296	−29	66	−11	34	12	4	VG	Do.
		7294	+29	124	+15	30	12	5		
		7293	+43	138	−13	46	48	8		
		7290	+49	144	+9	49	145	15		
		7287	+55	150	−12	57	218	1		
		7295	+58	153	−2	60	24	3		
		7292	+75	170	+15	75	242	6		
				(95)	(+7)		701	42		
Sept. 26	11 23	7299	−88	353	−8	88	24	1	G	Do.
		7298	−80	1	−6	80	24	1		
		7297	−75	6	+1	75	679	4		
		7293	+60	141	−15	63	12	3		
		7290	+65	146	+9	65	73	4		
		7287	+70	151	−13	73	194	2		
				(81)	(+7)		1,006	15		
Sept. 27	10 40	7299	−82	346	−6	82	291	6	G	Do.
		7299	−73	355	−8	74	388	14		
		7298	−65	3	−5	66	24	1		
		7297	−61	7	+2	62	679	3		
		7290	+79	147	+9	79	97	5		
		7287	+85	153	−12	85	145	1		
				(68)	(+7)		1,624	30		

POSITIONS, AREAS, AND COUNTS OF SUN SPOTS FOR SEPTEMBER 1941—Continued

Date	Eastern standard time	Mount Wilson group No.	Heliographic: Difference in longitude	Heliographic: Longitude	Heliographic: Latitude	Heliographic: Distance from center of disk	Area of spot or group	Spot count	Plate quality	Observatory
1941	*h m*		°	°	°	°				
Sept. 28	11 22	7299	−69	346	−6	70	145	11	G	U. S. Naval.
		7299	−61	354	−8	63	121	6		
		7298	−51	4	−6	52	24	1		
		7297	−48	7	+1	48	679	4		
				(55)	(+7)		969	22		
Sept. 29	11 5	7299	−54	348	−6	56	121	9	G	Do.
		7299	−49	353	−8	52	121	7		
		7298	−37	5	−6	39	24	1		
		7297	−35	7	+1	36	606	3		
				(42)	(+7)		872	20		
Sept. 30	13 47	7299	−39	348	−6	42	121	7	F	Do.
		7299	−34	353	−8	36	121	7		
		7298	−23	4	−6	26	48	1		
		7297	−20	7	+1	22	606	4		
				(27)	(+7)		896	19		

Mean daily area for 30 days=1,387.

*=not numbered.
VG=very good; G=good; F=fair; P=poor.

PROVISIONAL SUNSPOT RELATIVE NUMBERS FOR AUGUST, 1941

[Based on observations at Zurich. Data furnished through the courtesy of Prof. W Brunner; Eidgen, Sternwarte, Zurich, Switzerland]

August 1941	Relative numbers	August 1941	Relative numbers	August 1941	Relative numbers
1	108	11	68	21	70
2	*Ec* 97	12	52	22	*a* 76
3	*ad* 94	13	32	23	73
4	94	14	16	24	82
5	88	15	8	25	68
6	*b* 90	16	*d* 16	26	*a* 66
7	*a* 86	17	13	27	*d* 72
8	*a* 57	18	16	28	79
9	50	19	34	29	64
10	56	20	*Mcd* 48	30	50
				31	*d* 48

Mean, 31 days=60.2

a=Passage of an average-sized group through the central meridian.
b=Passage of a large group through the central meridian.
c=New formation of a group developing into a middle-sized or large center of activity. *E*, on the eastern part of the sun's disk; *W*, on the western part; *M*, in the central-circle zone.
d=Entrance of a large or average-sized center of activity on the east limb.

Chart I. Departure (°F.) of the Mean Temperature from the Normal, and Wind Roses for Selected Stations, September 1941

Chart I. Departure (°F.) of the Mean Temperature from the Normal, and Wind Roses for Selected Stations, September 1941

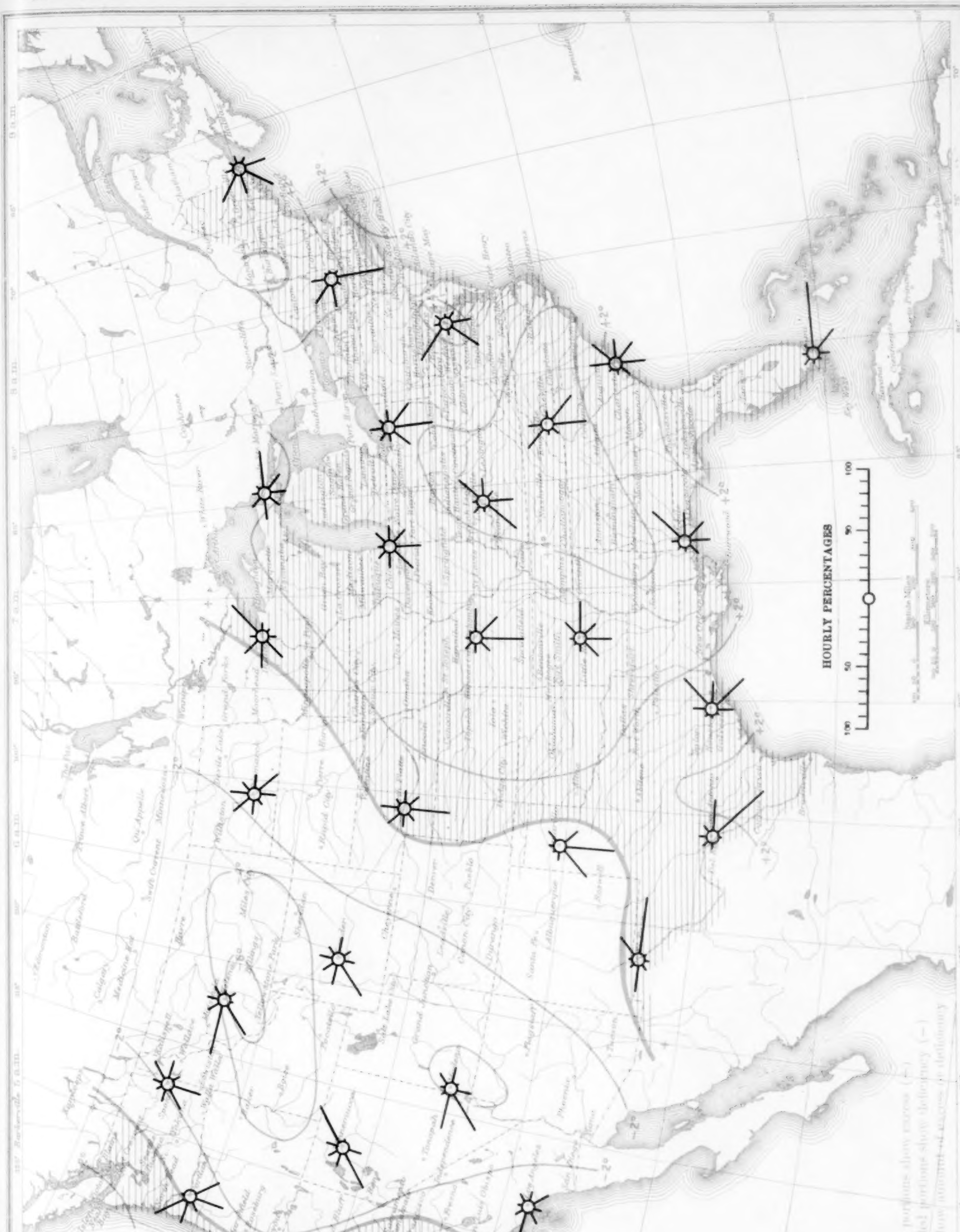
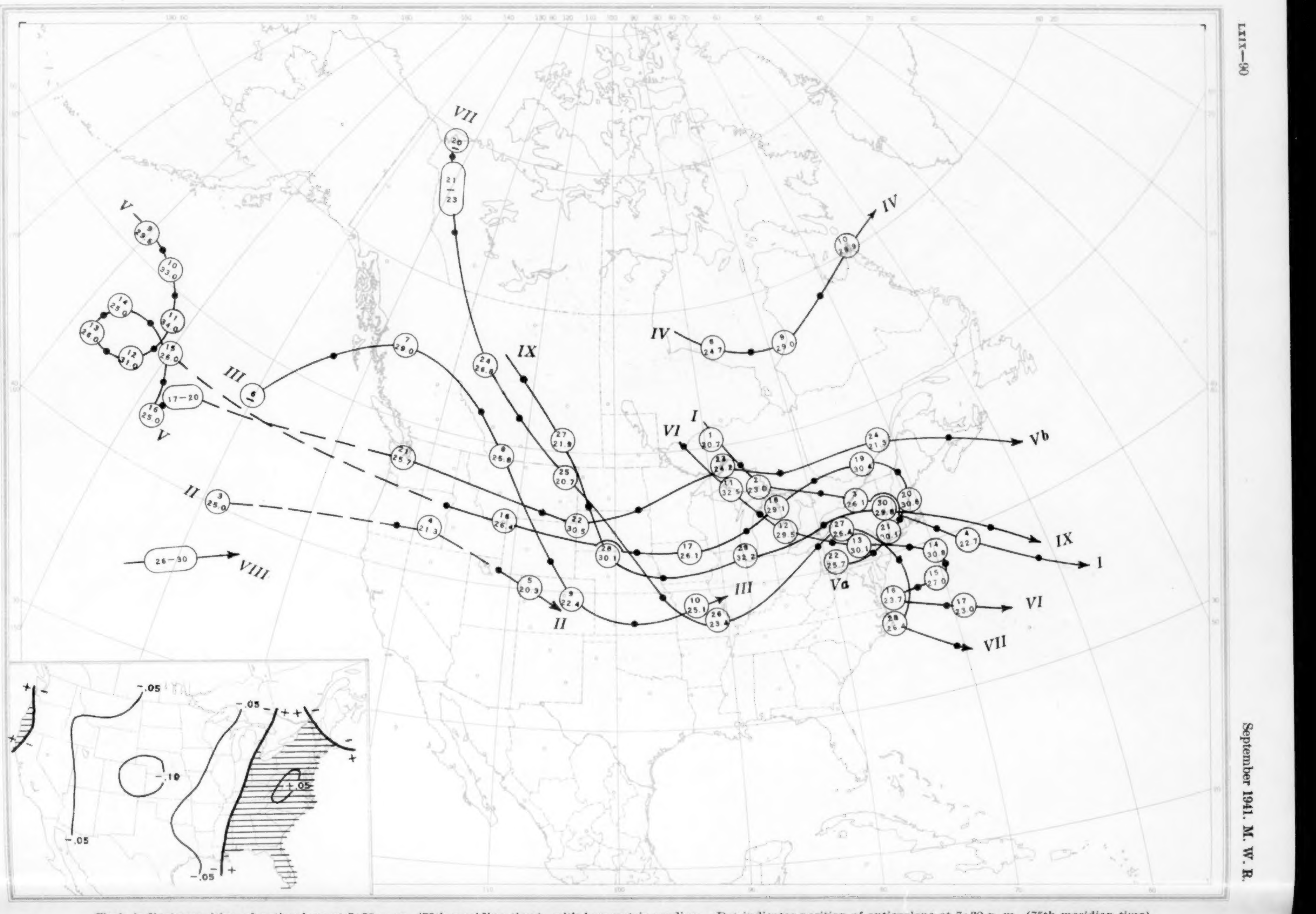


Chart II. Tracks of Centers of Anticyclones, September 1941. (Inset) Departure of Monthly Mean Pressure from Normal

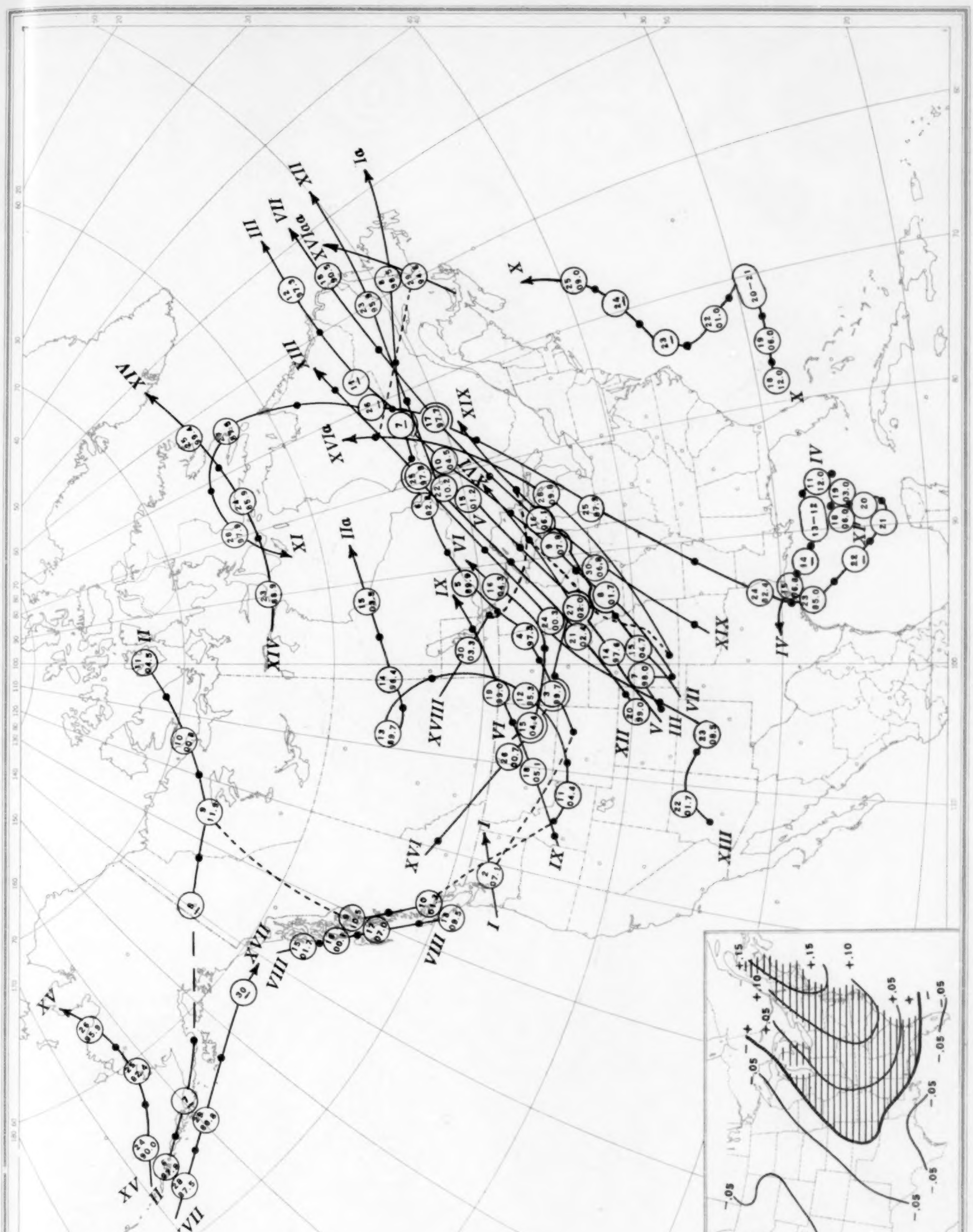


Circle indicates position of anticyclone at 7:30 a. m. (75th meridian time), with barometric reading. Dot indicates position of anticyclone at 7:30 p. m. (75th meridian time).

Chart III. Tracks of Centers of Cyclones, September 1941. (Inset) Change in Mean Pressure from Preceding Month

Circle indicates position of anticyclone at 7:30 a. m. (75th meridian time), with barometric reading. Dot indicates position of anticyclone at 7:30 p. m. (75th meridian time).

Chart III. Tracks of Centers of Cyclones, September 1941. (Inset) Change in Mean Pressure from Preceding Month



Circle indicates position of cyclone at 7:30 a. m. (75th meridian time), with barometric reading. Dot indicates position of cyclone at 7:30 p. m. (75th meridian time).

Chart IV. Percentage of Clear Sky Between Sunrise and Sunset, September 1941

Chart V. Total Precipitation, Inches, September 1941. (Inset) Departure of Precipitation from Normal

Chart V. Total Precipitation, Inches, September 1941. (Inset) Departure of Precipitation from Normal

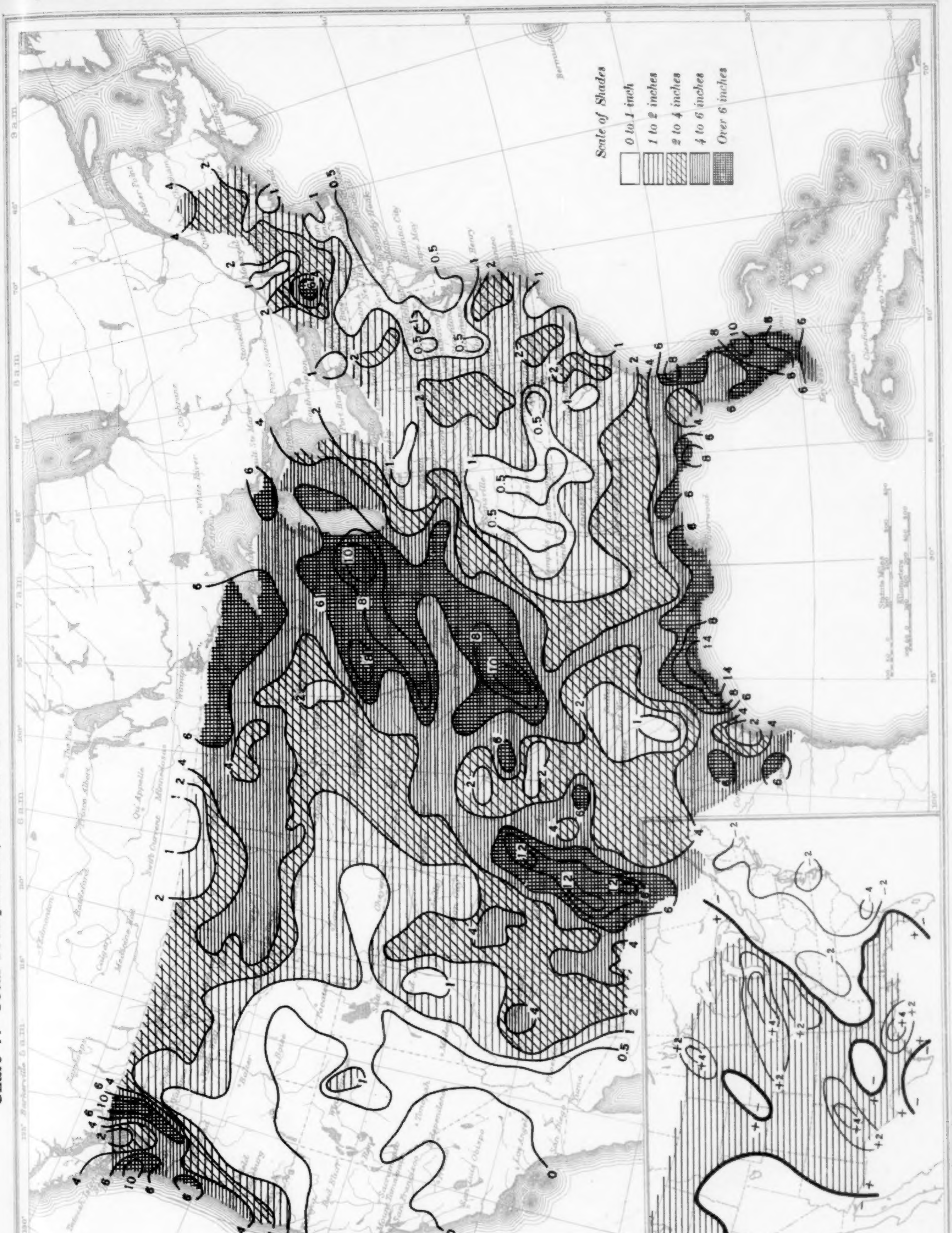


Chart VI. Isobars at Sea Level and Isotherms at Surface; Prevailing Winds, September 1941

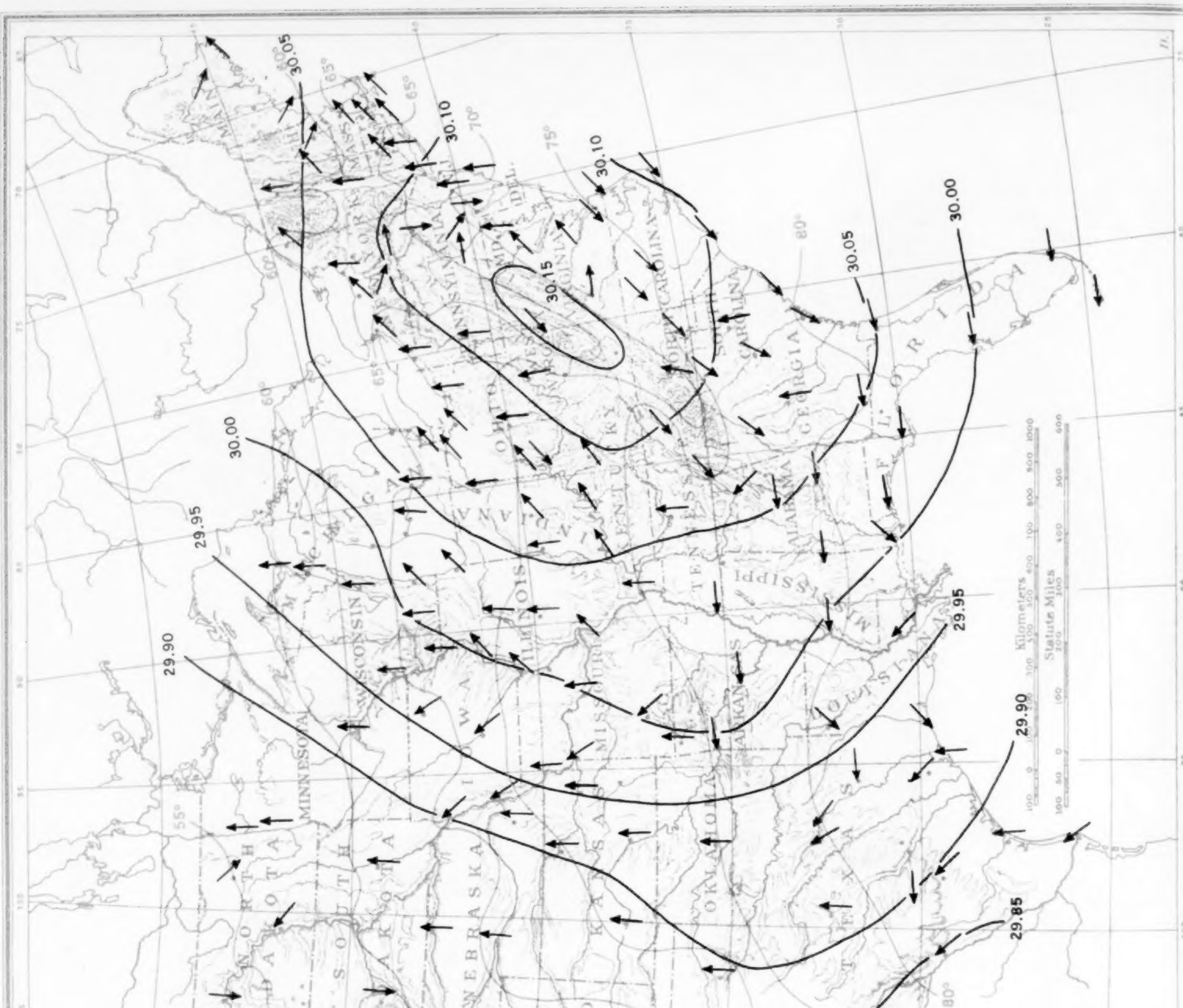


Chart VIII. Isobars (mb) for 1,524 Meters (5,000 ft.) and Isotherms (°C.) and Resultant Winds for 1,500 Meters (m. s.l.) September 1941
Isobars and isotherms based on radiosonde observations at 12:30 a. m. (E. S. T.) and winds based on pilot-balloon observations at 5:00 a. m. (E. S. T.).

Chart VIII. Isobars (mb) for 1,524 Meters (5,000 ft.) and Isotherms (°C.) and Resultant Winds for 1,500 Meters (m. s. l.) September 1941

Isobars and isotherms based on radiosonde observations at 12:30 a. m. (E. S. T.) and winds based on pilot-balloon observations at 5:00 a. m. (E. S. T.).

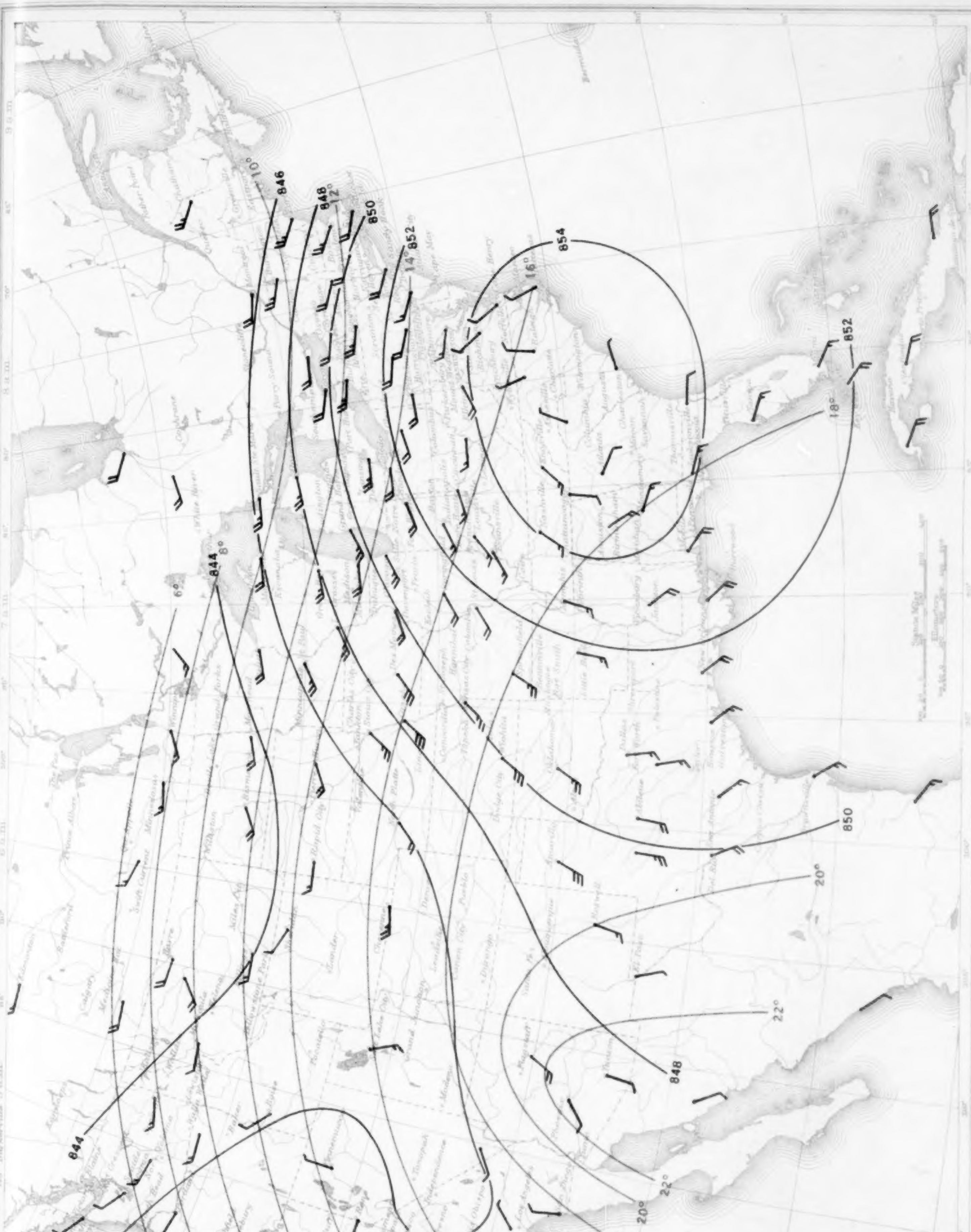
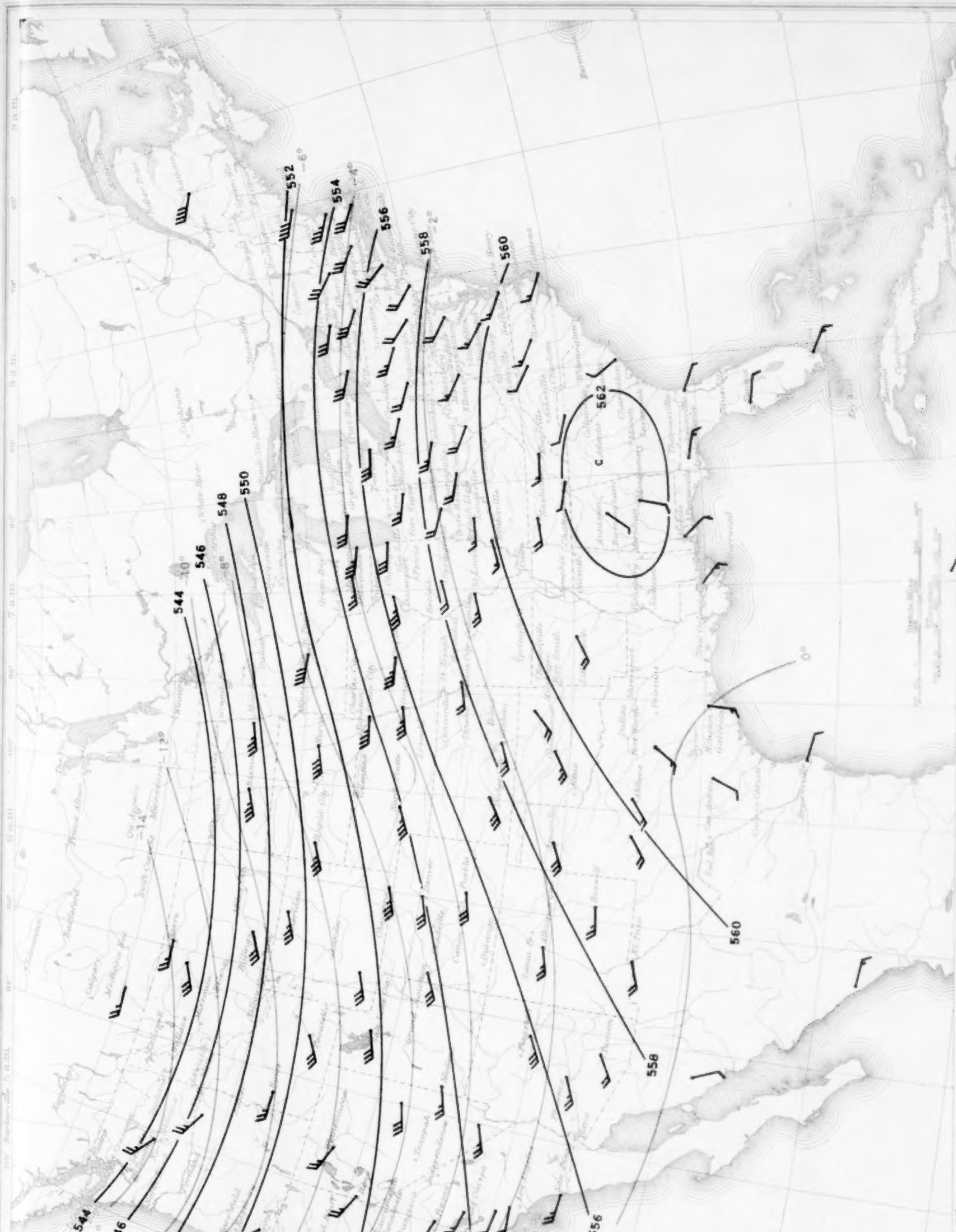


Chart IX. Isobars (mb) Isotherms (°C.) 1:00 a. m. (E. S. T) and Resultant Winds 5:00 a. m. (ES. T.) for 3,000 Meters (m. s. l.) September 1941

Chart X. Isobars (mb) Isotherms (°C.) 1:00 a. m. (E. S. T.) and Resultant Winds 5:00 p. m. (E. S. T.) for 5,000 Meters (m. s. l.) September 1941

Chart X. Isobars (mb) Isotherms (°C.) 1:00 a.m. (E. S. T.) and Resultant Winds 5:00 p.m. (E. S. T.) for 5,000 Meters (m. s. l.) September 1941



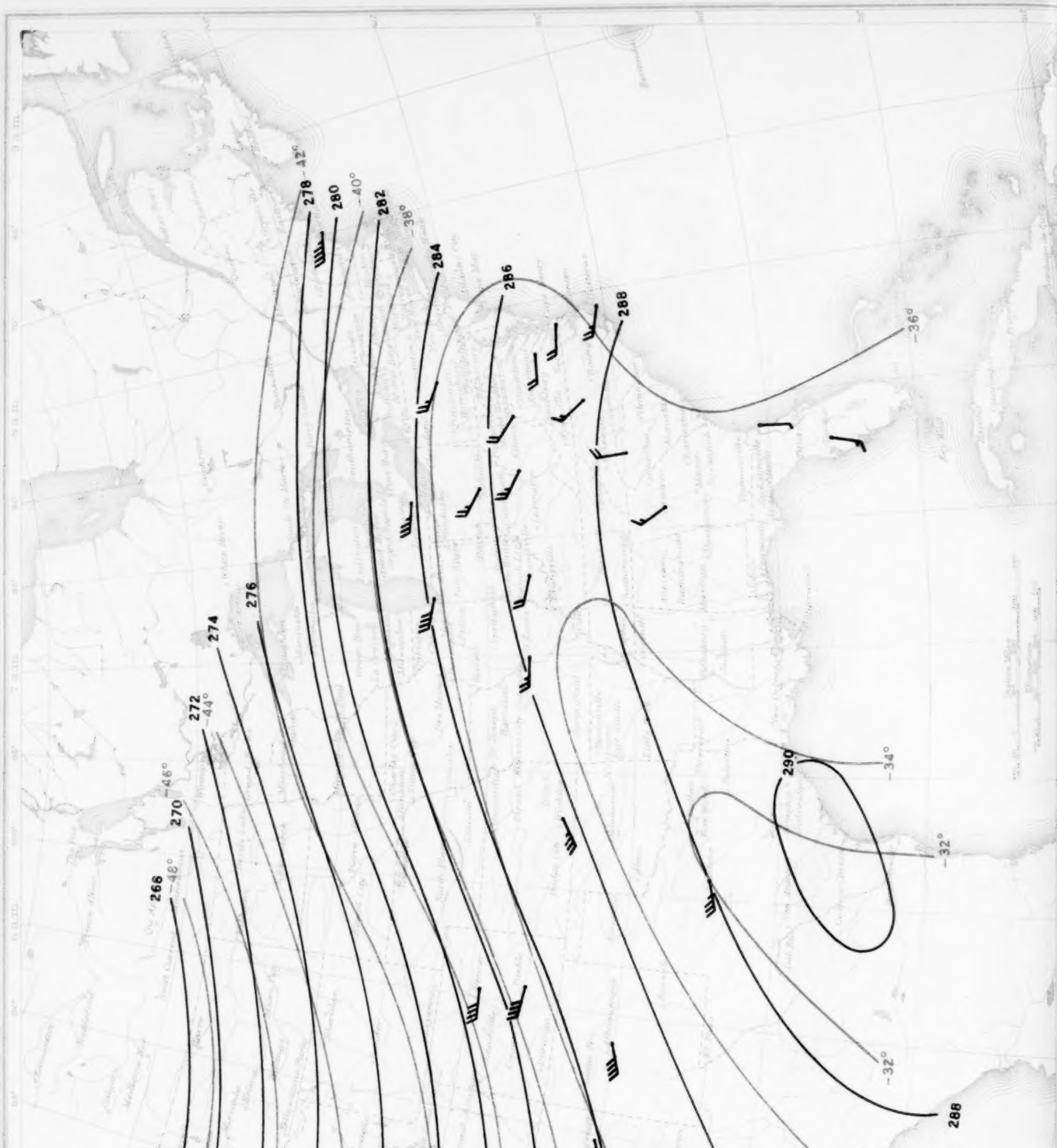


Chart XI. Isobars (mb) Isotherms (°C.) 1:00 a.m. (E. S. T.) and Resultant Winds 5:00 p.m. (E. S. T.) for 10,000 Meters (m. s. l.) September 1941